WATER RESOURCES INVESTIGATION

UNION VILLAGE DAM

OMPOMPANOOSUC RIVER, UNION VILLAGE VT.

CONNECTICUT RIVER BASIN

SITUATION REPORT

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

APRIL 1976

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UNION VILLAGE DAM
OMPOMPANOOSUC RIVER
UNION VILLAGE, VERMONT
CONNECTICUT RIVER BASIN

SITUATION REPORT

The Study and Report

PURPOSE OF STUDY

The purpose of this report is to review the operations of the Union Village Dam project, completed in 1950, and to determine whether their has been significantly changed physical or economic conditions that warrant modifications in this project with respect to hydrological and structural design criteria for earthquake, uplift, sliding and factor of safety. This situation report, although similar in scope and format to an authorized Section 216 study of the Flood Control Act of 1970, consists of a preliminary investigation of the project to determine the advisability of further detailed studies under the Section 216 Authority. The study was undertaken to:

Assure that the existing project is operationally safe as well as structurally sound in accordance with the most recent design criteria.

Determine the need for modifying or altering current use or for adding new purposes.

Update the project formulation to insure that the project will continue to make optimum contribution to the nations's economy.

Determine if there ia a need for additional land acquisition for the project or if there is a surplus of property for project needs.

Examine the current environment to insure compatibility with environmental considerations.

Recommend modifications to structures, operation, or environmental aspects where necessary.

SCOPE OF THE STUDY

The scope of this study is preliminary in nature. The investigations and analysis of technical data are discussed only so far as they affect the overall operational efficiency of the project, and were coordinated with the appropriate Federal, State or local agencies, as well as other concerned individuals. A consulting engineering firm, Fay, Spofford and Thorndike of Boston, Massachusetts, performed the structural analysis of the concrete structures, which was done under contract and by direction of the New England Division.

COORDINATION WITH OTHER AGENCIES

Comments were requested from various Federal, State and local officials to determine their desires or needs for modifying the project or its operation. The following agencies were contacted:

FEDERAL

Environmental Protection Agency
Fish and Wildlife Service
National Park Service
Bureau of Outdoor Recreation
Department of Housing and Urban Development
Soil Conservation Service

STATE OF VERMONT

Agency of Environmental Conservation
Water Resources Department
Department of Recreation
Vermont Natural Resources Council
Central Planning Office
State Planning Office
Division of Water Supply and Pollution Control
Water Conservation Board
Interagency Commission on Natural Resources
Environmental Board
Forests and Parks Department
Department of Highways
Fish and Game Service

REGIONAL AND LOCAL INTERESTS

New England River Basins Commission
Town of Thetford

THE REPORT

Engineering Circular 1110-2-119, "Review of Operation of Existing Projects," dated 1 September 1971 served as a guideline for the preparation of this report. Results are presented in two parts: the main report and the appendix. The main report presents a broad view of the overall investigation with supportive maps, photographs, relevant data and recommendations. The appendix contains the pertinent correspondence in connection with the study, and also the technical reports.

PRIOR STUDIES AND REPORTS

The Ompompanoosuc River watershed has a long history of flooding, extending back more than 150 years. During that time, the only reports prepared were survey-type, pertaining to the entire Connecticut River basin. Reports which included the Ompompanoosuc River and the Union Village Dam and Reservoir are as follows:

a. Report of Survey and Comprehensive Plan for Protection of the Connecticut River Valley. Submitted to Congress on 20 March 1937. Authorization of the plan is contained in the Flood Control Act of 1938 (Public Law 75, 75th Congress, 1st Session) and the Flood Control Act of 1944 (Public Law 534, 78th Congress, 2nd Session).

b. Flood Control Measures Adopted by the States of Connecticut, Massachusetts, New Hampshire and Vermont, approved on 6 June 1953, Public Law 52, 83d Congress.

c. "The Resources of the New England-New York Region," Part Two, Chapter XXI, dated March 1955 and printed in Senate Document 14, 85th Congress. It consisted of a comprehensive survey of land, water and related natural resources of the region. The report, prepared by the New England-New York Interagency Committee, was submitted to the President of the United States by the Secretary of the Army on 27 April 1956.

d. Comprehensive Water and Related Land Resources, Connecticut River Basin, dated June 1970. This study recommended the establishment of a summer recreation reservoir pool contingent upon the solution to the existing water quality problem on the West Branch, fish and wildlife enhancement, water supply, and agricultural use of the riverbed during non-flood periods.

e. Manual of Reservoir Regulation for the Union Village Dam and Reservoir. Revised by the Corps of Engineers, New England Division, in May 1971.

f. Operation and Maintenance Manual for the Union Village Dam, Published by the Corps of Engineers, New England Division, in June 1972.

g. Vermont Statewide Comprehensive Outdoor Recreation Plan (SCORP), published in 1973. The study describes the river upstream of Union Village as an "outstanding stretch of river" and having a potential for swimming.

h. Periodic Inspection Report No. 1. This report on the Union Village Dam was prepared by Goldberg-Zoino and Associates, Inc., Consultants in Geotechnical Engineering, Newton Upper Falls, Massachusetts, in April 1975. No immediate remedial action was recommended to insure the stability, safety and adequacy of the dam on the basis of their inspection. Routine maintenance items were, however, recommended, as well as another periodic inspection in 1978.

Resources and Economy

PROJECT DESCRIPTION

The Union Village Dam Project is a unit of the comprehensive plan for flood control in the Connecticut River Basin, which was authorized by the Flood Control Acts of 22 June 1936, as amended, and 28 June 1938 (House Document 445, 75th Congress, 2nd Session). The dam is located on the Ompompanoosuc River, four miles above its junction with the Connecticut River. It is one-fourth mile north of Union Village and 11 miles north of White River Junction, Vermont. See PLATE 1.

The dam is rolled-earth fill with rock slope protection. It has a length of 1,100 feet, a top width of 30 feet and a maximum height above riverbed of 170 feet. The spillway is a chute-type, ogee weir, 388 feet long founded on rock and is located off the right abutment of the dam. The outlet works are in the left abutment of the dam and consists of a 13-foot diameter circular conduit, 1,167 feet long founded on rock, and two rectangular gates, 7'-6" x 12'-0", mechanically operated through a shaft in the gatehouse above. The reservoir capacity is 38,000 acre-feet, which is equivalent to 6.65 inches of runoff from a drainage area of 126 square miles. Pertinent data for the existing project is shown in TABLE 1, on page 6.

Construction of Union Village Dam and appurtenant facilities began in March 1947 and was completed in June 1950. The project, together with other units in the Connecticut River Basin provides flood protection for downstream communities in Vermont, New Hampshire, Massachusetts and Connecticut. The total project cost was $4,210,000 including the provision of recreational public use facilities. There have been 28 significant operations of the project to reduce downstream river stages. In the operation of April 1969, the reservoir reached 53 percent of capacity. Total damages prevented since completion of the project amount to $1,402,000. In a recurrence of the March 1936 basin flood of record, the project would prevent over $10,000,000 in damages.

Presently, the recreational facilities are operated and managed by the Corps of Engineers. Development consists of a small day-use area with facilities for swimming, and picnicking. Sightseeing, fishing, hunting and snowmobiling are also major activities at the project site.

TABLE 1
PERTINENT DATA

UNION VILLAGE DAM AND RESERVOIR

LOCATION	Ompompanoosoc River, Union Village, Vermont
DRAINAGE AREA	126 Sq. Mi.
RESERVOIR	
PERMANENT POOL	None
FLOOD CONTROL STORAGE	
Capacity - Acre Feet	38,000
- Inches of Runoff	5.65
Area at Crest - Acres	720
Length - Miles	3.5
DAM	
Type	Rolled earth fill and rock slope
Length - feet	1,100
Top elev. ft - msl	584
Height above river bed	170
DIKES	None
SPILLWAY	
Type	Chute spillway/ogee weir
Length	388 feet
Elevation	564 feet
CONTROL WORKS	
Type	13' diameter tunnel
Length - feet	1,167
Invert elev. - msl	420
Gates - 2 Broom type	7'-6" x 12'-0"
TOTAL QUANTITIES	
Embankmane Volume - cy	1,720,000
Concrete - cy	17,000
TOTAL COST	$4,041,700
OPERATIONAL DATE	March 1950
PROJECT AREA	
Fee/Easement (Acres)	1,292/4
RECREATIONAL FACILITIES	13 Picnic tables, 7 fireplaces, 3 parking areas, water supply, trails and beach (Managed by Corps of Engineers)

ENVIRONMENTAL SETTING

Union Village Dam project is located in the Ompompanoosuc River watershed in East central Vermont, primarily in Orange county with a small portion in Windsor county. The watershed is roughly fan shaped about 14 miles long by 12 miles wide, and covers about 126 square miles. See PLATE 2. The terrain is steep and conducive to rapid runoff. The elevation of the perimeter of the basin varies from over 2,300 feet above msl in the northwestern headwaters to about 600 msl near the dam. The only significant storage in the watershed is Lake Fairlee, located on a tributary to the Ompompanoosuc River about seven miles north of Union Village Dam.

The Ompompanoosuc River watershed has a variable climate characterized by frequent but generally short periods of heavy precipitation in the summer and longer periods of less intense precipitation in the winter months. The mean annual precipitation in the summer and longer periods of less intense precipitation in the winter months. The mean annual precipitation over the basin is about 36 inches distributed rather uniformly throughout the year. Runoff for 24 years of record at the U.S.G.S. stream gage, located just downstream at the Union Village Dam, has averaged 19.6 inches per year. Mean annual snowfall is about 87.7 inches, with about 45 percent of this amount falling in the months of January and February. Water content of the snow cover reaches a maximum about the middle of March, and from 1951 to date has averaged about 6.0 inches with a maximum of 10.5 inches and a minimum of 3.3 inches. Moderately high springtime discharges occur as a result of melting snow, but runoff from this source alone has not caused a major flood. Flooding due to a combination of snowmelt and heavy rains is an annual possibility.

NATURAL RESOURCES

The valleys of the main stem and West Branch of the Ompompanoosuc join to form the narrow fork shaped reservoir area behind Union Village Dam. The West Branch is affected by drainage from an abandoned copper mining operation upstream.

Pools, rapids, flumes and small waterfalls at various locations along the natural beds of both streams provide attractive settings for outdoor enjoyment. White waters of the main stem, cascading over rocky ledges below the Tucker Mountain Road covered bridge, provides a picturesque setting for one of the few remaining structures of this type

in central Vermont. Water quality of the main stem above river mile 5 is acceptable for bathing and fishing, but locations suitable for recreational development are limited in size.

DEVELOPMENT AND ECONOMY

Historical population data for the Ompompanoosuc River watershed and Orange county are shown below:

	1940	1950	1960	1970
Ompompanoosuc	3,318	3,147	2,909	3,288
Orange County	17,048	17,027	16,014	17,272

The major reason for the decline in the areas population between 1940 and 1960 appears to be a change in agricultural technology, which decreased the number of man hours needed to produce a given quantity of milk. In addition, the development of the milk supply area in Boston resulted in the processing of milk to be moved from the farms and local creameries to plants in the Boston area. The production of cheese and butter in small creameries and cheese plants, which once provided numerous local jobs, was also relocated. All in all, less and less employment has been provided by the entire chain of milk processing and a population migration was the natural extension.

A similar process can be observed in the technology of forest products. Not only does it require fewer man hours per 1,000 board feet of timber cut but much of the processing which at one time was done locally is now done either out of State or in larger and more efficient sawmills within the State. Furthermore, the market for many Vermont forest products was saturated during the forties and fifties by efficient large scale West Coast producers.

Thus, areas like the Ompompanoosuc watershed where farming and woodworking were important sectors of the local economy have shown the greatest population loss, especially where few employment opportunities occurred to replace those lost. In the 1960's the process of decline in population for the watershed area had reached a certain degree of maturity so that by 1970 the decline was being offset by the effects of alternative employment opportunities.

In the late 1960's the recreation and vacation home industries began to develop in the watershed and resulting employment gains helped to offset the previous migration caused by the faltering farming and woodworking industries. As the importance of agriculture as a source of employment to the areas economy decreased, the significance of recreation facilities such as Lake Fairlee and those facilities available for skiing enthusiasts became more important. In addition to the various inns, lodges and childrens camps, numerous vacation home cottages were also erected around the lake. In recent years, not only has there been increases in summer employment connected with recreation, but there appears to be some tendency toward a general increase in winter employment. This is attributed, in part at least to the development of skiing as a major recreation industry. Although there are no major ski facilities located in the watershed, winter recreationists, nevertheless, do pass through the area, stop and spend money.

Investigations

GENERAL

Investigations were made in the following areas: real estate; hydrology; water quality, operations and flood regulations; foundations and materials; structural analysis; and environmental evaluation. The investigations included general operation of the project and any problems which may have become apparent through the investigations.

REAL ESTATE

Reservoir lands comprise approximately 1,276 acres, of which the Government owns 1,272 acres in fee, and the perpetual right and easement to overflow an additional four acres. The guide contour elevation is 564.0 feet msl, which is also the spillway elevation. The existing boundary lines appear to be adequate enough to safeguard against the effects of saturation, wave action, and bank erosion. As a result of this review, no project land changes are necessary for the efficient operation of the project.

HYDROLOGY

A hydrologic analysis of the Union Village Dam was made in accordance with current spillway design flood criteria. Included were sections on floods of record, unit hydrograph development, probable maximum rainfall, reservoir routings and spillway hydraulics. The study concluded that the spillway capacity at Union Village Dam is adequate under current hydrologic design criteria, and no alterations in design are necessary. The Hydrologic Review is included in Appendix 1, Section A.

WATER QUALITY

Union Village Dam controls 126 square miles of the Ompompanoosuc River. The seasonally dry bed reservoir impounds a 50 acre winter pool with a 400 acre foot capacity to prevent ice formation in the outlet works. The river has been classified as a Class B stream by the Vermont Legislature.

Class B waters are suitable for bathing, recreation, irrigation and agricultural uses. They must be of good esthetic value which can also be used for public water supply with filtration and disinfection. The river reach in the immediate area of the project also must meet Type II state water specifications for dissolved oxygen concentrations. A Type II stream must have a dissolved oxygen concentration of not less than 6 mg/1. During impoundment, the winter pool must meet Type V state water specifications for lakes, ponds and reservoirs, natural or artificial. Dissolved oxygen concentrations for this type cannot be below 5 mg/1 if caused by the addition of oxygen demanding wastes and other material. Class B waters must have a pH value between 6.5 and 8.0 standard units (su). In addition, total coliform bacteria must not exceed 500 colonies/100 ml while fecal coliform must not exceed 200 colonies/100 ml.

6.5 to 8.0 range has been exceeded in 17 percent of the samples. The maximum value obtained is 8.4 su while the minimum is 5.9 su. The state color standard of 25 Platinum-Cobalt Units (Pt-Co Units) was equalled or exceeded in 20 percent of the samples. The mean color value for a greater than 4 year period is 15 su, with a high of 30.

Total coliform bacteria levels exceeded state standards of 500 colonies/100 ml for the Ompompanoosuc River in 40 percent of the samples. The mean value for a greater than 4 year period is approximately 1,400 colonies/100 ml with a maximum count of 8,000 and a minimum of 20.

No major dissolved oxygen concentration problem has developed in the discharge waters during any season.

Since those parameters that exist in concentrations exceeding state standards for Class B, Type II streams are present in both the inflow and discharge waters, any degradation of the river cannot be attributed to the presence or operation of Union Village Dam. Degradation of the Ompompanoosuc River occurs at unidentified point and nonpoint sources upstream from the dam.

OPERATIONS AND FLOOD REGULATION

Reservoir regulation functions of the New England Division are performed by the Reservoir Control Center (RCC), which is part of the Water Control Branch of the Engineering Division. During normal (non-flood) periods at Union Village, both gates are normally left open three feet to keep the reservoir empty. Retention of a pool buildup is held to a minimum period of time, with the reservoir being emptied as rapidly as possible, maintaining safe downstream channel capacities.

During the winter months, one gate is closed and the other throttled to maintain a reservoir stage of approximately 20 feet, to prevent ice buildup on the gate slides. During flood periods, Union Village Dam is regulated as required, to provide protection to downstream communities.

There have been no significant operational difficulties during flood control periods since the completion of construction and there is no present need to change the reservoir regulation procedures.

FOUNDATIONS AND MATERIALS

The updated review of the existing project is as follows:

1. Embankment Stability.

a. The embankment stability studies for the design of Union Village Dam, as presented in the Analysis of Design, have been reviewed in the light of current practice and criteria. This review covered the selection of design shear strength parameters, methods of stability analysis and the performance record of the embankment.

b. The design shear strength parameters were developed from the results of laboratory shear tests. Procedures for the development of these design parameters, however, have changed significantly since that time (1938) and for purposes of this review new parameters were derived from the original tests results by current methods.

c. The methods of embankment stability analysis used in designing the dam embankment are among those prescribed in Engineer Manual EM 1110-2-1902, Stability of Earth and Rock-Fill Dams. The cases analyzed, however, did not include all of those currently considered. The embankment, therefore, was reanalyzed, using the new shear strength parameters, for the following cases:

(1) Sudden Drawdown
(2) Steady Seepage
(3) Partial Pool

d. The dam embankment has been in place for almost 26 years. During this time, there have been numerous cycles of reservoir filling and drawdown. The embankment has shown no evidence of unsatisfactory performance with respect to possible embankment or foundation shear failure.

e. As a result of this review the following conclusions are drawn.

(1) Although procedures for the selection of design shear strength parameters have changed significantly since the design of this embankment, satisfactory factors of safety were obtained using new parameters in the stability analysis done for this review.

(2) Except for the limited number of cases considered, the embankment stability analysis for the design of this dam were donducted in accordance with current procedures.

(3) The results of this review indicate that the stability of the dam embankment against shear failure satisfy current criteria.

2. Seepage Control. The seepage control studies for the design of Union Village Dam, as presented in the Analysis of Design, have been reviewed in the light of current practice and criteria. This review covered flownet analysis, the development of filter gradation specifications, the designs of the seepage control features and the performance record of the dam embankment. It was found that the seepage control design procedures and criteria are essentially the same as those in current use and that current seepage control criteria are satisfied. In almost 34 years of operation, moreover, the embankment has shown no evidence of unsatisfactory performance with respect to seepage.

STRUCTURAL ANALYSIS

The stability analysis of the concrete structures was performed by Fay, Spofford and Thorndike, Inc., Consulting Engineers, Boston, Massachusetts.

The structures were analyzed under a number of loading cases which included normal operating conditions, new earthquake loadings, and combinations thereof. Structures analyzed were as follows:

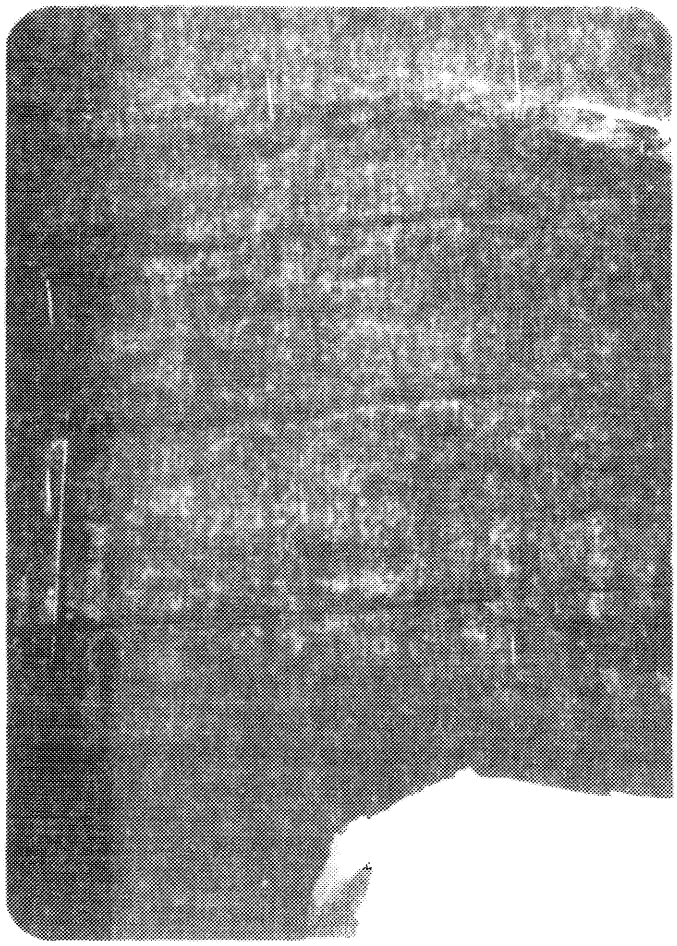
Operating (Gate) House
Outlet Channel Retaining Wall
Spillway (Ogee Weir)
Spillway Walls

The operating house and outlet channel retaining walls satisfy, in all cases, the requirements of the new criteria for stability, and no remedial modifications or strengthening is required.

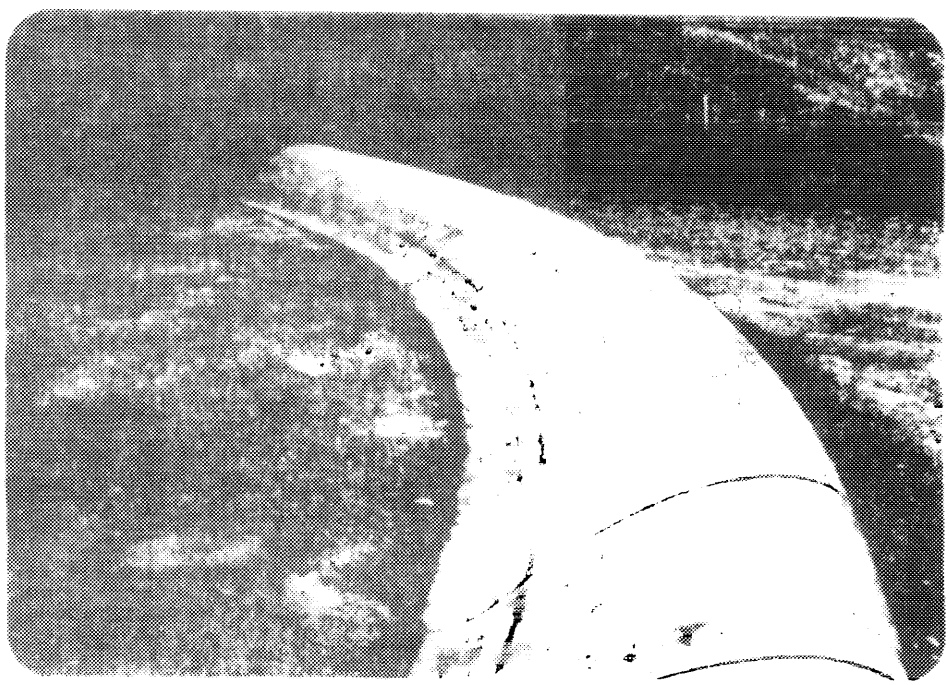
The spillway weir and spillway retaining wall basically satisfies the new criteria, except that the location of the resultant force, under adverse case loadings, does not satisfy the "middle third" criteria. Recommended remedial measures include rock anchors along the crest of the weir, and tie-rod anchors or additional mass concrete for the spillway wall. The deficiency is not critical and remedial measures will be given further consideration under the Operations and Maintenance Program, Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures, as directed by ER 1110-2-100. The structural report is included in Appendix 1, Section B.

ENVIRONMENTAL EVALUATION

The project manager of the completed project performs the operating and maintenance work in such a manner so as to prevent, to the extent practicable, environmental pollution from Government activities, as well as activities by others, on Government property. Efforts are made to prevent chemical, physical or biological elements or agents from adversely affecting human health and welfare through the alteration of ecological balances by unwise use and management. Consideration is especially given to air, water, and noise pollution, as well as land despoilment.



Spillway left training wall, close-up view showing good condition.



Spillway ogee weir and right rock cut wall, looking west.

Management of the existing project resources on a multiple use basis has provided the greatest benefits for esthetics, wildlife, agriculture, hunting and fishing, and other seasonal recreational purposes.

Problems and Needs

The majority of the recreational usage at this project is from local area residents, however, a number of areawide visitors also utilize the facilities. Litter, vandalism, and unauthorized usage are the most important problems, but these have diminished in recent years through increased patrols by project personnel and the addition of park rangers.

Slumping of seeded slopes, shoreline erosion, and sedimentation are minimal problems and no action is necessary at this time.

Fishery resources in the area are severely limited by heavy metals (copper, lead, zinc) from an abandoned copper mine slag dump located in the West Branch of the Ompompanoosuc River, however, there appears to be no pressure to increase the fisheries potential of the project at this time.

Present recreational use at this project consists primarily of sightseeing, picnicking, swimming, snowmobiling, hunting and fishing with facilities for these activities considered adequate.

NED personnel met with the town of Thetford selectmen on 5 January 1976, in response to their letter of 15 December 1975 (Appendix 2). Selectmen informed that local and State enforcement agencies are permitted to patrol and make arrests on the Federal reservation.

Although visitor control problems surfaced in 1972, the situation has improved and public use of the area in 1975 was free of any serious problems. The selectmen explained that the concerns described in their letter were intended to represent problems that came to their attention at various times in the past and that, in fact, they received very few complaints during 1975. They were unaware of many of our efforts in the reservoir (ranger patrols, etc.) during the past two years and expressed overall concurrence with the directions that management of this area is taking.

Views of Other Interests

Over twenty letters were sent to Federal and local agencies, as well as other interests, asking for their comments, desires, and views on reformulating the completed project. Statements by those interests expressing views or making recommendations are contained in Appendix 2, and summarized as follows:

FEDERAL

U.S. Department of Agriculture. They are not aware of any need to reformulate the existing project.

U.S. National Park Service. Cannot substantiate the need for reformulation of the project.

U.S. Fish and Wildlife Service. They recommend that the dam and reservoir area be maintained in its present state.

U.S. Bureau of Outdoor Recreation. A general field investigation of the area was made, but no conclusions were drawn about the projects current or potential level of recreational use.

NON-FEDERAL

New England River Basins Commission. Recommended that the Corps investigation include water quality, recreational use, and agricultural use when project is normally dry.

Vermont Natural Resources Council. No specific comments about reformulation.

Vermont Environmental Board. No comments.

Vermont Highway Department. Any alterations to the dam would not affect their highways or bridges in the area.

Town of Thetford, Vermont. Concerned about unauthorized use of bathing area, and feel added control is needed.

Vermont Department of Water Resources. Recommended that water quality be thoroughly investigated and water supply, hydropower, and more beach area be considered in the investigation.

Summary

The Union Village Dam and Reservoir is a single purpose flood control project located on the Ompompanoosuc River in the Connecticut River Basin. The dam is of rolled earthfill with a dumped rock shell 170 feet high and 1,100 feet long. It is located about one-quarter mile upstream of Union Village.

The total cost of the project was $4,041,000 and became operational in 1950. The reservoir is operated as a part of a flood control system in the Connecticut River Basin. The water resources within the project area support limited fisheries, wildlife habitat, and related small scale recreational uses.

There have been 28 significant flood storage operations since the project became operational. Total damages prevented to date amount to $1,402,000. In the operation of April 1969, the reservoir reached 53 percent capacity.

Investigations conducted in: real estate; hydrology; water quality, operations and flood regulations; foundations and materials; and environmental evaluation, revealed that there is no need for reformulation in those areas.

Structural stability studies indicate that corrective action is required to bring some of the concrete structures into conformity with up-to-date design criteria. However, since this situation is not critical at this time, it will be given further consideration under the normal Operations and Maintenance Program.

Conclusions

Findings conclude that:

Structural modifications consisting of rock anchors are required on the spillway weir, and spillway wall in order to comply with updated design criteria, however, the deficiency is not critical at this time.

The present operations and flood regulations of the project are satisfactory.

There is no justification at this time to expand the purposes served by the Union Village Dam beyond the primary flood control purpose in accordance with its original design.

There is no need for acquiring additional land or relinquishing any of the present real estate holdings.

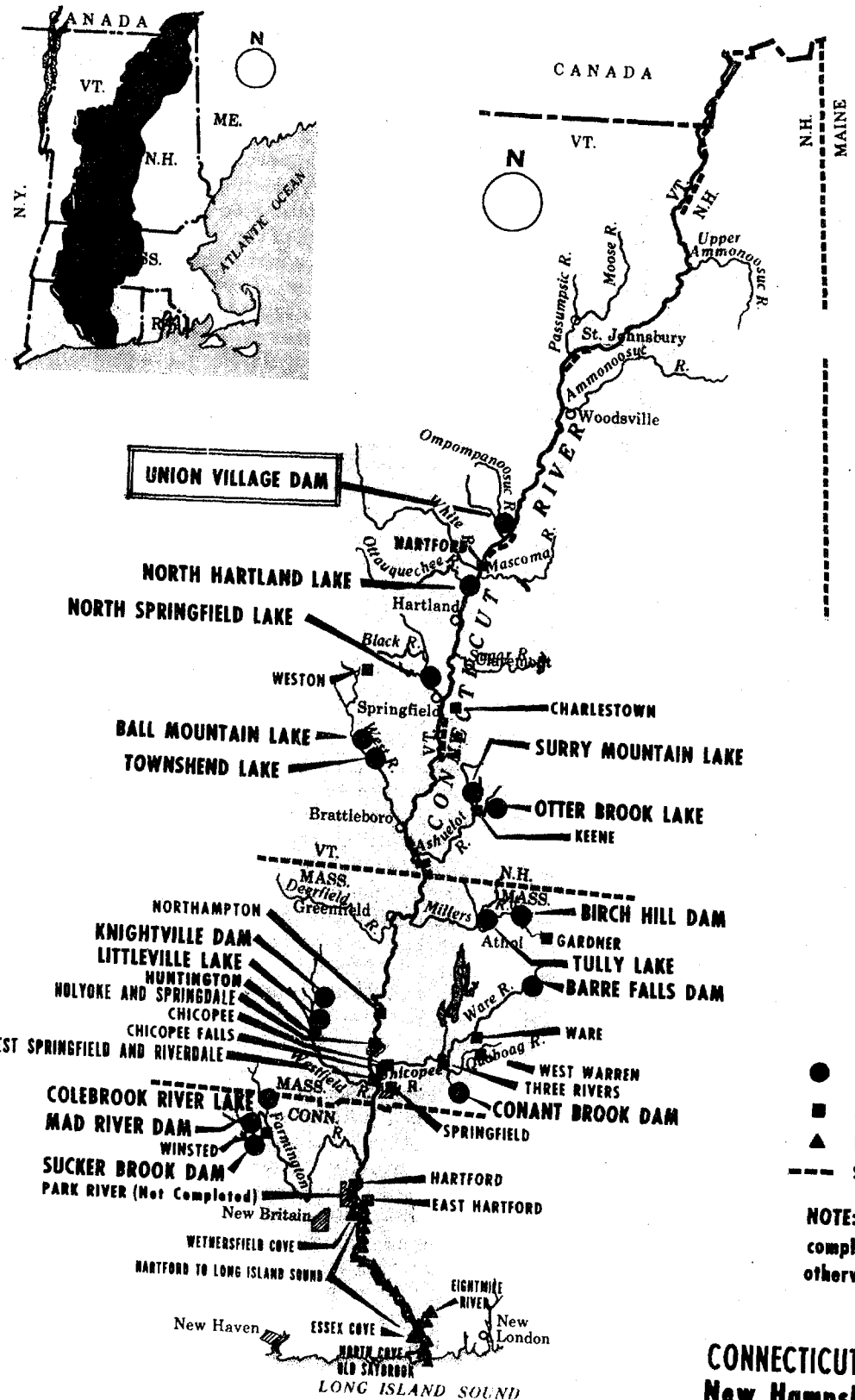
There is no justification for providing additional recreational uses or facilities, at this time.

The existing project has no adverse effects on the environment.

Recommendations

It is recommended that no reformulation of current uses and/or operation of the completed project be made at this time. Based on this situation report, no further detailed studies are recommended under the 1970 Flood Control Act.

JOHN H. MASON
Colonel, Corps of Engineers
Division Engineer



LEGEND

- RESERVOIRS
- LOCAL PROTECTION PROJECT
- NAVIGATION PROJECTS
- STATE BOUNDARY

NOTE: All projects completed unless otherwise noted

CONNECTICUT RIVER BASIN
New Hampshire, Vermont, Massachusetts & Connecticut

SCALE IN MILES
8 0 8 16 24

PLATE 1

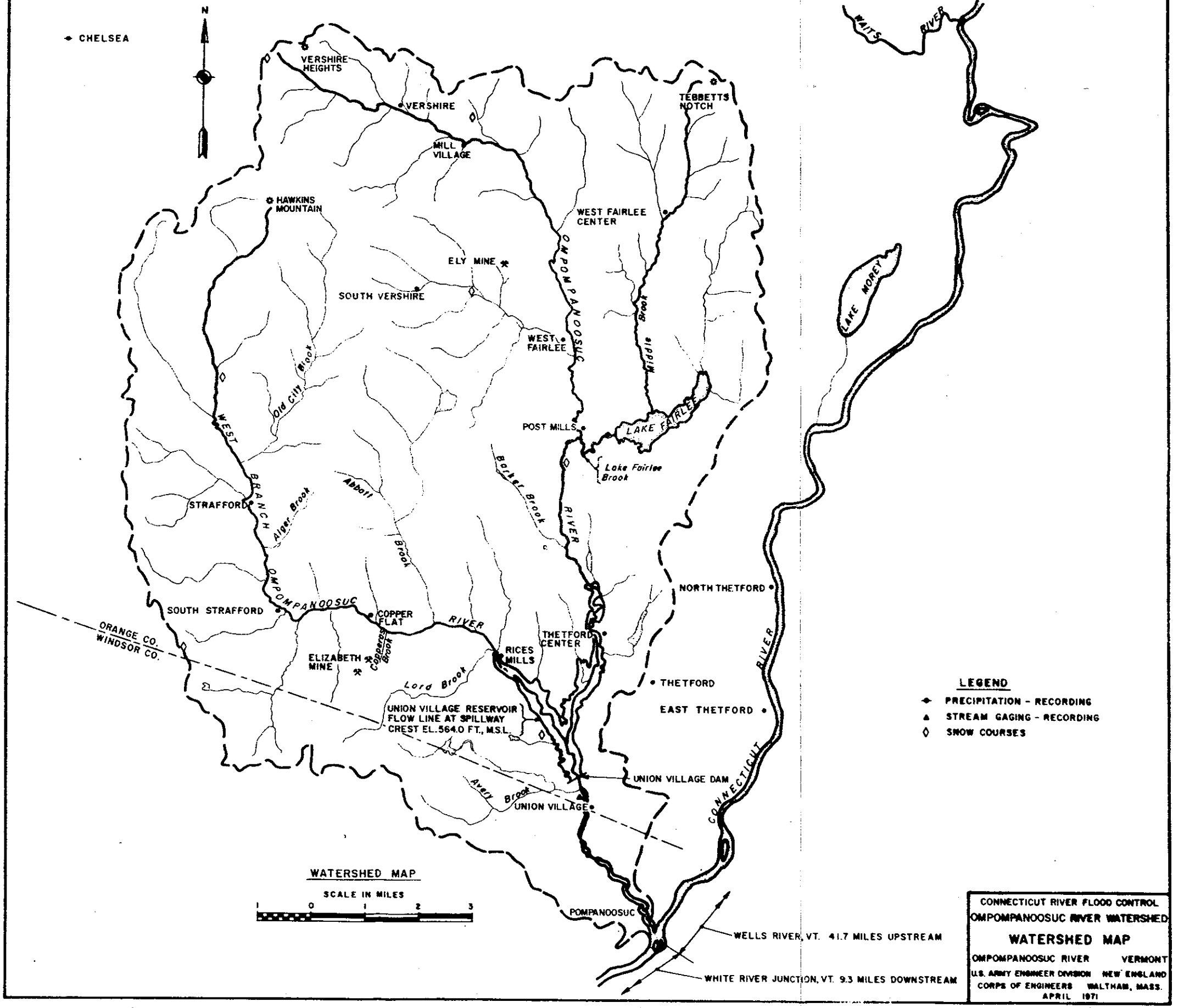
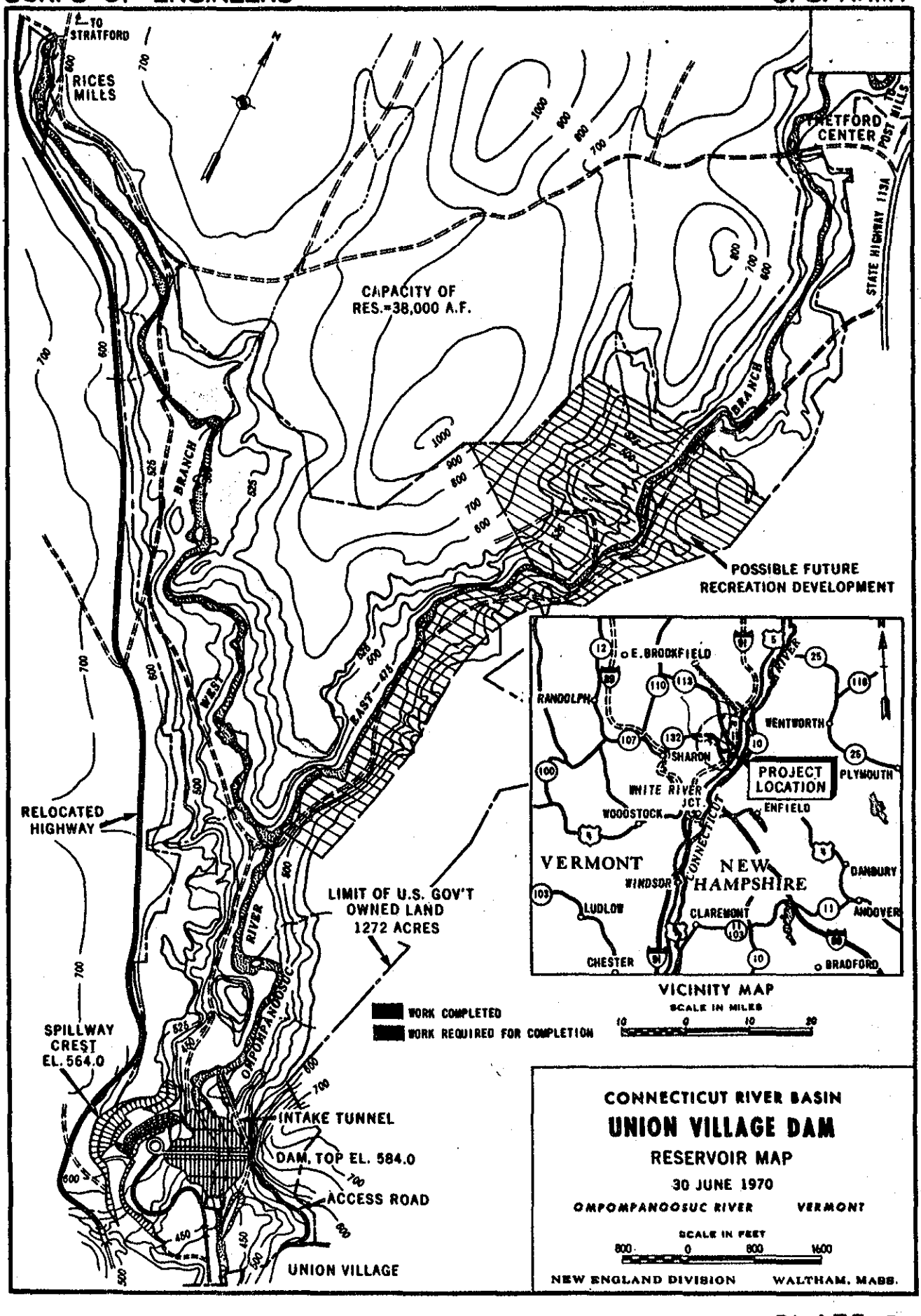

N
CHELSEA
VERSHIRE HEIGHTS
VERSHIRE
MILL VILLAGE
TEBBETTS NOTCH
HAWKINS MOUNTAIN
WEST FAIRLEE CENTER
ELY MINE
SOUTH VERSHIRE
WEST FAIRLEE
Old City Brook
WEST BRANCH
OMPOMPANOOSUC
Middle Brook
POST MILLS
LAKE FAIRLEE
Lake Fairlee Brook
Barber Brook
RIVER
Alger Brook
Abbott Brook
STRAFFORD
SOUTH STRAFFORD
COPPER FLAT
Copperas Brook
ELIZABETH MINE
Lord Brook
RICES MILLS
THETFORD CENTER
NORTH THETFORD
THETFORD
EAST THETFORD
ORANGE CO.
WINDSOR CO.
UNION VILLAGE RESERVOIR
FLOW LINE AT SPILLWAY
CREST EL. 564.0 FT., M.S.L.
Avery Brook
UNION VILLAGE
UNION VILLAGE DAM
CONNECTICUT RIVER
POMPANOOSUC
WELLS RIVER, VT. 41.7 MILES UPSTREAM
WHITE RIVER JUNCTION, VT. 9.3 MILES DOWNSTREAM
WAITS RIVER
LAKE MOREY
LEGEND
PRECIPITATION - RECORDING
STREAM GAGING - RECORDING
SNOW COURSES
WATERSHED MAP
SCALE IN MILES
0 1 2 3
CONNECTICUT RIVER FLOOD CONTROL
OMPOMPANOOSUC RIVER WATERSHED
WATERSHED MAP
OMPOMPANOOSUC RIVER VERMONT
U.S. ARMY ENGINEER DIVISION NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.
APRIL 1971

PLATE 2

CORPS OF ENGINEERS U. S. ARMY



CONNECTICUT RIVER BASIN

UNION VILLAGE DAM

RESERVOIR MAP

30 JUNE 1970

OMPOMPANOOSUC RIVER *VERMONT*

SCALE IN FEET

800 0 800 1600

NEW ENGLAND DIVISION WALTHAM, MASS.

PLATE 3

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

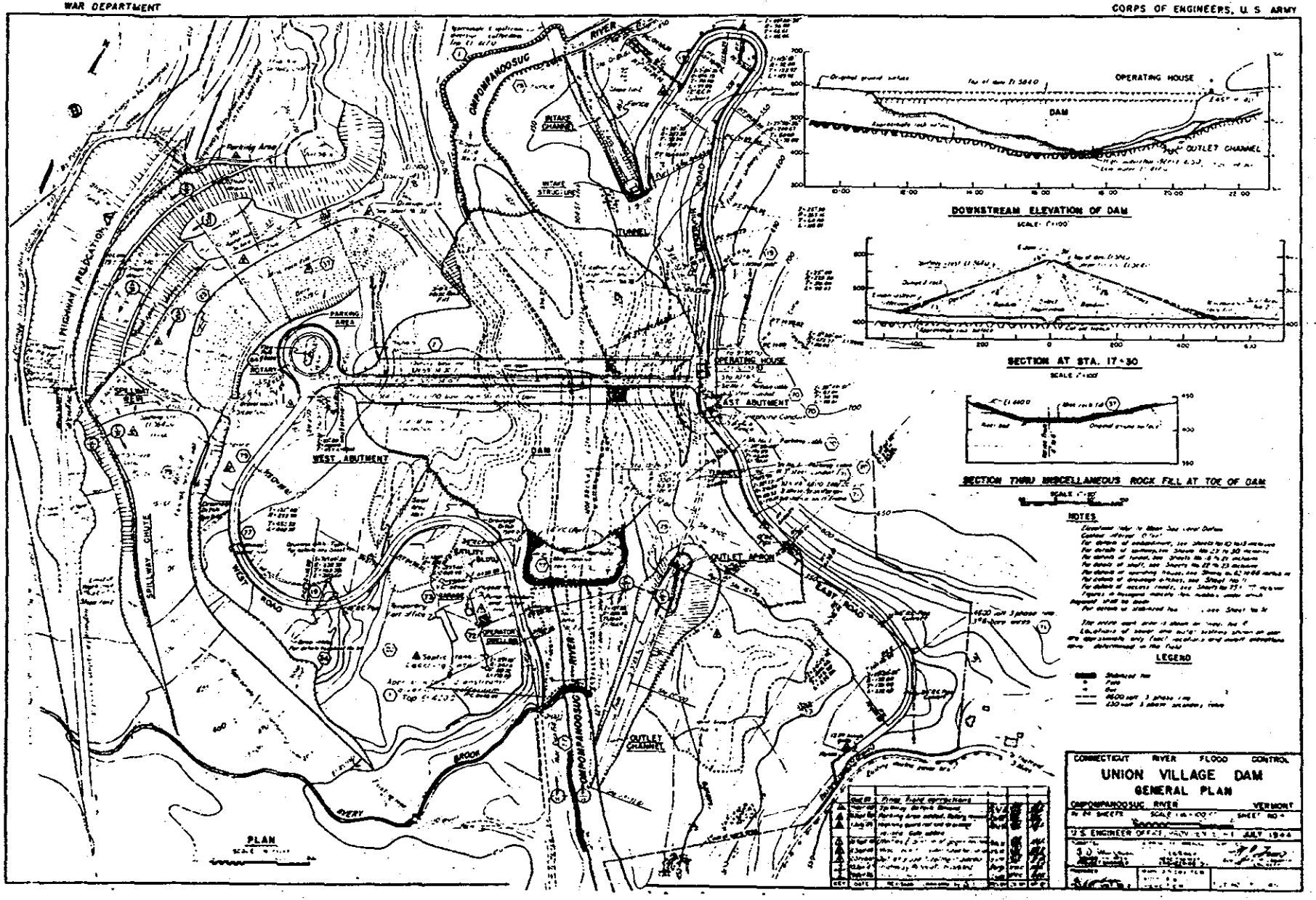


PLATE 4

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APPENDIX 2 - PERTINENT CORRESPONDENCE

APPENDIX 1

TECHNICAL REPORTS

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SECTION B - STABILITY ANALYSIS OF STRUCTURES

SECTION A

HYDROLOGIC REVIEW

HYDROLOGIC REVIEW OF SPILLWAY DESIGN
UNION VILLAGE DAM
OMPOMPANOOSUC RIVER WATERSHED-CONNECTICUT RIVER BASIN
VERMONT

1. PURPOSE

This report presents a hydrologic review of spillway requirements for Union Village Dam in accordance with current spillway design flood criteria. Included are sections on project description, unit hydrograph development, probable maximum rainfall, reservoir routings and spillway hydraulics.

2. CONCLUSION

As a result of this study, it was concluded that the spillway capacity at Union Village Dam is adequate under current hydrologic design criteria.

3. PROJECT DESCRIPTION

Union Village Dam, completed in 1950, is located in east central Vermont on the Ompompanoosuc River. It is about four miles upstream of the confluence of the Ompompanoosuc and Connecticut Rivers and about one-fourth mile north of Union Village. The reservoir has a total storage capacity of 38,000 acre-feet, equivalent to 5.65 inches of runoff from its drainage area of 126 square miles. Except for a small winter pool of 400 acre-feet, the entire 38,000 acre-feet of storage are reserved for flood control. At spillway crest, the reservoir has a maximum depth of 144 feet and a water surface area of about 740 acres.

The Ompompanoosuc River watershed above Union Village Dam is roughly fan shaped and about 14 miles long by 12 miles wide. A map of the watershed is shown on PLATE 1. The terrain is steep and conducive to rapid runoff. A profile of the river is shown on PLATE 2. The elevation of the perimeter of the basin varies from over 2,300 feet msl in the northwestern headwaters to about 600 feet msl near the dam, with an average elevation of about 1,300 feet msl. The

watershed has one major tributary--the West Branch Ompompanoosuc River, with a drainage area of 60 square miles. The only significant storage in the watershed is Lake Fairlee, located on a tributary to the Ompompanoosuc River about seven miles north of Union Village Dam.

4. CLIMATOLOGY

The mean annual precipitation over the basin is about 36 inches, distributed rather uniformly throughout the year. Runoff for 24 years of record at the U.S. Geological Survey (USGS) stream gage, located just downstream of the Union Village Dam, has averaged about 19.6 inches per year. Mean annual snowfall is about 87.7 inches, with about 45 percent of this amount falling in the months of January and February. Water content of the snow cover reaches a maximum about the middle of March, and from 1951 to date has averaged about 6.0 inches with a maximum of 10.5 inches and a minimum of 3.3 inches. Moderately high springtime discharges occur as a result of melting snow, but runoff from this source alone, during the period of record, has not caused a major flood. Serious flooding due to a combination of snowmelt and heavy rains is a possibility nearly every year.

5. FLOODS OF RECORD

Floods have occurred on the Ompompanoosuc River during all seasons of the year. The floods of November 1927, June 1973 and October 1869 were caused by heavy rainfall alone; whereas, the floods of February 1867 and March 1936 resulted from heavy rain accompanied by melting snow. A list of the six largest floods and estimated peak discharges from 1867 to date is shown below in TABLE 1.

TABLE 1

ESTIMATED PEAK DISCHARGES AT
LOCATION OF UNION VILLAGE DAM

Event	Discharge in cfs
November 1927	12,000
June 1973	9,500
February 1867	7,300
October 1869	7,300
March 1936	7,300

6. UNIT HYDROGRAPH DEVELOPMENT

A unit hydrograph was developed for the 126 square mile watershed based on analysis of the computed inflow hydrograph of the recent flood of June 1973 and associated rainfall data recorded at the Union Village Dam. The peak of the resulting unit hydrograph was increased by 55 percent in accordance with procedures prescribed in paragraph 25 of EM 1110-2-1405 to reflect a more intense and pronounced watershed response to a storm such as that associated with the spillway design flood. Pertinent data on the adopted unit hydrograph are included in TABLE 3. The adopted unit hydrograph is shown graphically on PLATE 3. It is noted that the peak discharge of the unit graph used in this study is about 4 percent greater than that used in the original design, and about 20 percent less than that developed in a 1967 study of spillway requirements.

7. PROBABLE MAXIMUM PRECIPITATION

The probable maximum precipitation (PMP) for the watershed was determined using criteria contained in Hydrometeorological Report 33. A 24-hour rainfall index of 18.5 inches was determined for a 200 square mile area in the Union Village vicinity. This value was adjusted to 17.15 inches/24 hours to account for the smaller size and shape irregularities of the watershed. Rainfall excess values of a 6-hour unit duration were than computed by subdividing the 24-hour rainfall values and subtracting an assumed constant loss rate index of .067 inches/hour.

8. SPILLWAY DESIGN FLOOD INFLOW

The spillway design flood inflow hydrograph was computed by applying the 6-hour rainfall excess values to the adopted 6-hour unit hydrograph. The resulting hydrograph is shown on PLATE 4. It is noted that the ordinates of the spillway design flood were increased by 1,000 cfs (8 csm) to account for baseflow,

9. RESERVOIR ROUTINGS OF SPILLWAY DESIGN FLOOD

The spillway design flood (SDF) was routed through Union Village reservoir using the traditional relationship of "inflow = outflow + change of storage." Routings were performed, using an updated spillway rating curve and assuming flood control gates to be operable and in accordance with the latest regulation procedures. TABLE 2 lists pool stage versus discharge relationships considered appropriate for this study.

TABLE 2

POOL STAGE-DISCHARGE RELATIONS
SPILLWAY SURCHARGE CONDITIONS

Pool Elevation (ft msl)	Spillway Discharge (cfs)	Outlet Gate Settings (ft) (2 gates)	Outlet Discharge (cfs)	Total Discharge (cfs)
564	0	0-0	0	0
566	3,560	0-0	0	3,560
568	10,525	0-6	3,500	14,025
570	20,020	6-6	7,000	27,020
572	31,875	12-12	8,000	39,875
574	41,130	12-12	8,000	49,130
576	62,260	12-12	8,000	70,260
578	97,870	12-12	8,000	87,870
580	99,575	12-12	8,000	107,575

Two antecedent pool stage conditions were considered: reservoir filled to spillway crest and 50 percent full at the beginning of SDF inflow. The results of the two routings are included in TABLE 3 and shown graphically on PLATE 4.

10. FREEBOARD REQUIREMENTS

In the original design of Union Village Dam a freeboard allowance of 5 feet above the maximum surcharge of the spillway design flood was adopted. Current criteria specify that 3 feet of freeboard should be allowed above the maximum surcharge of the SDF occurring with an antecedent full pool, and that 5 feet should be added to maximum surcharge of the flood occurring with the reservoir initially half full. The top of dam elevation is then determined on the basis of the higher resulting elevation, provided that wave runup and wind tide requirements are met. In this study, wave action computations were not made, Rather, a review was made of these computations done in conjunction with the previously mentioned 1977 study of spillway adequacy. It was concluded that, since the latter of the two routing conditions described above would be more critical, 5 feet of freeboard would be required, and hence, freeboard would exceed allowances for wave action.

It is noted that an analysis was made of the possible effects of a dam failure at Lake Fairlee, the only water body of appreciable

TABLE 3

HYDROLOGIC DESIGN CRITERIA
UNION VILLAGE DAM AND RESERVOIR

Item	Original Design Criteria	1967 Study	1974 Criteria 216 Study Condition I	1974 Criteria 216 Study Condition II
SPILLWAY DESIGN STORM				
Basis of Design	USWB	HR #33	HR #33 & EC 1110-2-27	
Volume of Rainfall (in/24 hrs)	17.2	17.0	17.15	17.15
UNIT HYDROGRAPH				
Unit Rainfall Dur (hrs)	6	6	6	6
Tp (lag) (hr)	5.5	-	5.7	5.7
Peak Flow (cfs)	8,000	10,750	8,290	8,290
SPILLWAY DESIGN FLOOD				
Peak Inflow to Res (cfs)	87,500	110,000	97,000	97,000
Base Flow (cfs)	-	-	1,000	1,000
Peak Outflow (cfs)	84,900	105,000	95,700	95,100
Volume of Runoff (ac-ft)	110,600	106,000	107,145	107,145
RESERVOIR REGULATION PLAN				
Initial Pool Elev (ft msl)	564	564	564	532
Outlet Facil. during Flood	Closed	Operable	Operable	Operable
MAXIMUM SURCHARGE (ft msl)	579	580.4	578.8	578.5
FREEBOARD CHARACTERISTICS				
Design Wind Velocity (mph)	60	80	-	-
Effective Fetch (mi)	2.5	0.65	-	-
Average Depth (ft)	-	100	-	-
Wave Runup (ft)	4.6	3.4	-	-
Wind Tide (ft)	0.2	Negligible	-	-
(Allowance for upstream dam breach (ft)	-	-	(1.2)	(1.2)
Adopted Freeboard (ft)	5.0	5.0	3.0	5.0
REQUIRED TOP OF DAM ELEV(ft msl)	584	585.4	581.8	583.5

storage in the basin. Although it is unlikely that the dam was designed to discharge flows of SDF magnitude and would probably breach under such conditions, a breach would not, at most, increase maximum surcharge more than 1.2 feet. No additional freeboard was added to allow for a possible upstream dam failure.

11. COMPARISON OF STUDY RESULTS WITH ORIGINAL DESIGN

Table 3 compares the hydrologic criteria and findings of this study with that data reported in the "Analysis of Design," dated July 1944. Also tabulated are the findings of the more abbreviated study of spillway requirements that was performed in 1967.

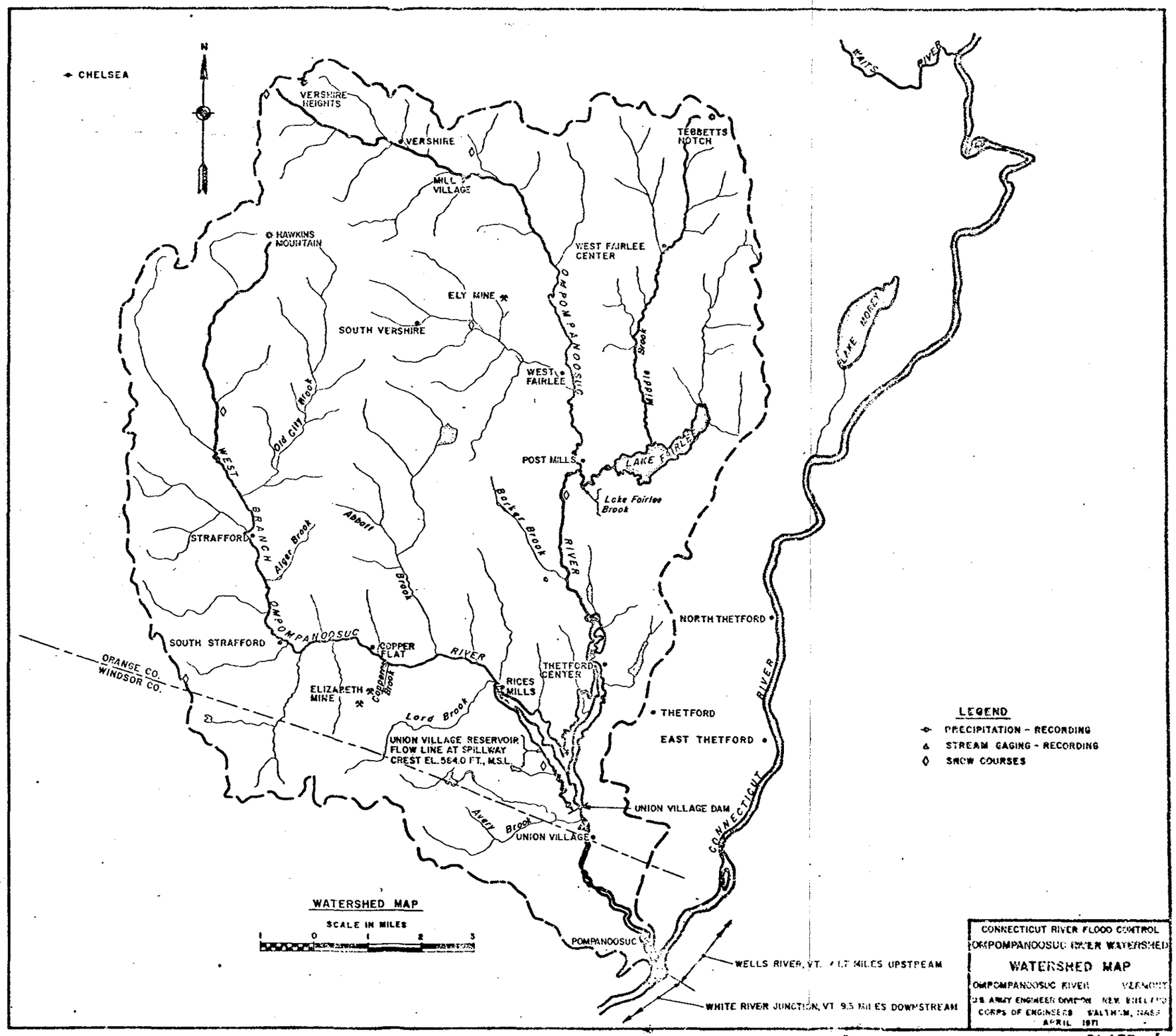
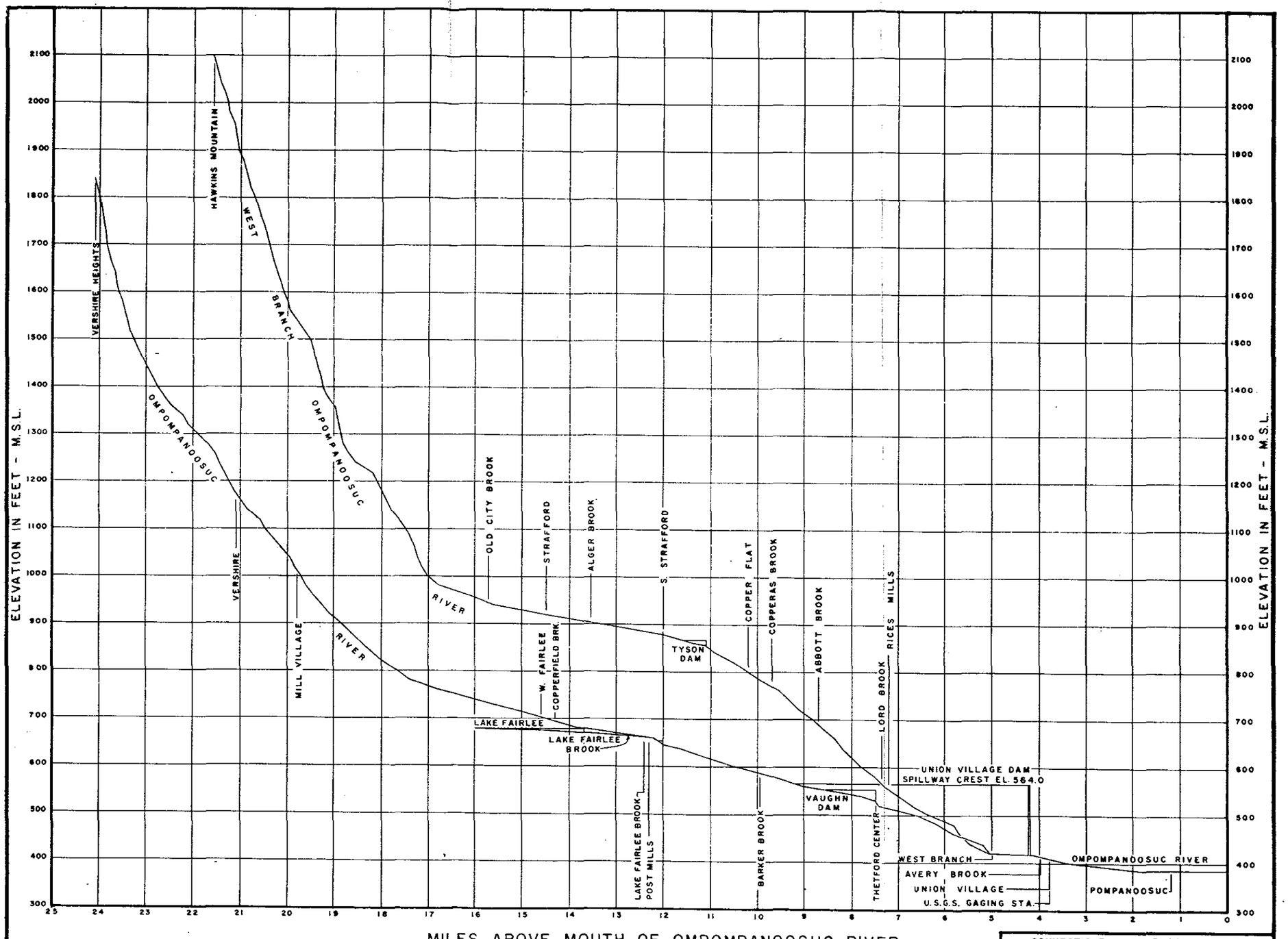

CHELSEA
N
VERSHIRE HEIGHTS
VERSHIRE
MILL VILLAGE
TEBBETTS NOTCH
HAWKINS MOUNTAIN
WEST FAIRLEE CENTER
ELY MINE
SOUTH VERSHIRE
OMPOMPANOOSUC
WEST FAIRLEE
Trout Brook
Old Gulf Brook
WEST BRANCH
POST MILLS
LAKE FAIRLEE
Lake Fairlee Brook
Abbott Brook
Barker Brook
RIVER
STRAFFORD
Alger Brook
OMPOMPANOOSUC
NORTH THETFORD
SOUTH STRAFFORD
COPPER FLAT
RIVER
ORANGE CO.
WINDSOR CO.
ELIZABETH MINE
Copperas Brook
Lord Brook
THETFORD CENTER
RICES MILLS
THETFORD
EAST THETFORD
UNION VILLAGE RESERVOIR
FLOW LINE AT SPILLWAY
CREST EL. 564.0 FT., M.S.L.
UNION VILLAGE DAM
Avery Brook
UNION VILLAGE
CONNECTICUT RIVER
POMPANOOSUC
WELLS RIVER, VT. 41.7 MILES UPSTREAM
WHITE RIVER JUNCTION, VT 9.5 MILES DOWNSTREAM
WAITS RIVER
BLAKE MOREY
LEGEND
PRECIPITATION - RECORDING
STREAM GAGING - RECORDING
SNOW COURSES
WATERSHED MAP
SCALE IN MILES
0 1 2 3
CONNECTICUT RIVER FLOOD CONTROL
OMPOMPANOOSUC RIVER WATERSHED
WATERSHED MAP
OMPOMPANOOSUC RIVER VERMONT
U.S. ARMY ENGINEER DIVISION NEW ENGLAND
CORPS OF ENGINEERS WALTHAM, MASS.
APRIL 1971

PLATE 1



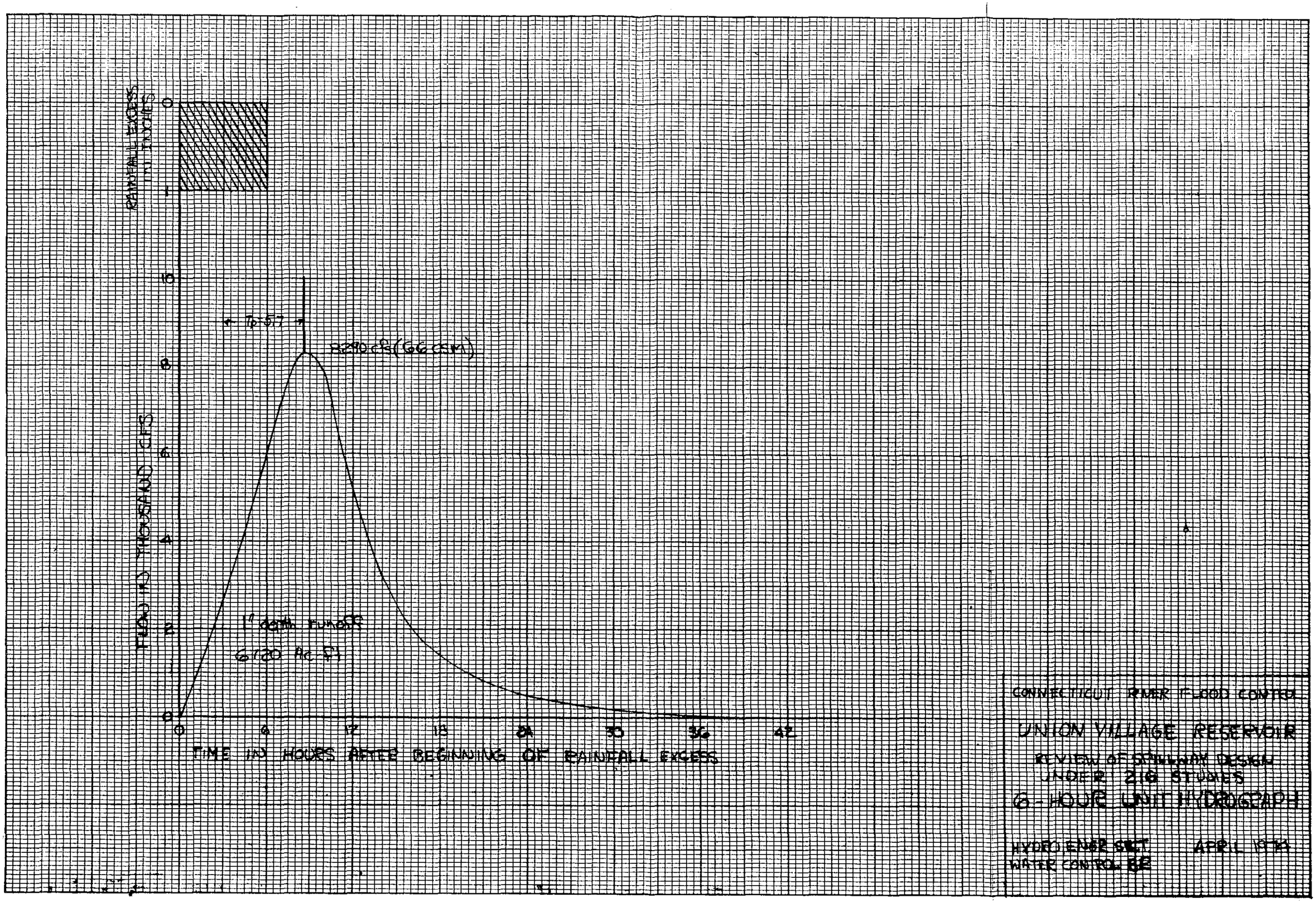
CONNECTICUT RIVER FLOOD CONTROL

OMPOMPANOOSUC RIVER WATERSHED RIVER PROFILES

NEW ENGLAND DIVISION WALTHAM, MASS.

FEBRUARY 1971

PLATE 2



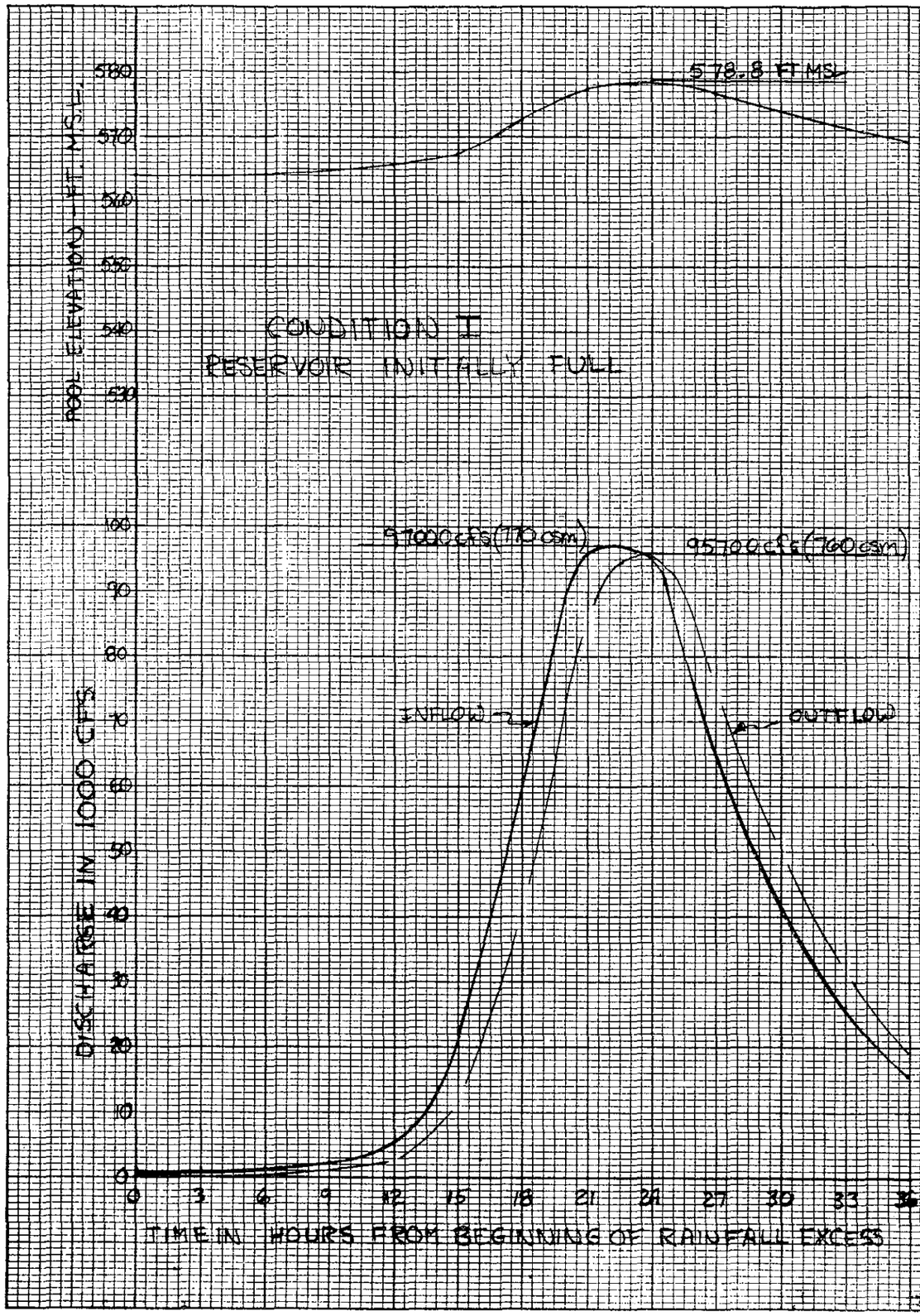
CONNECTICUT RIVER FLOOD CONTROL

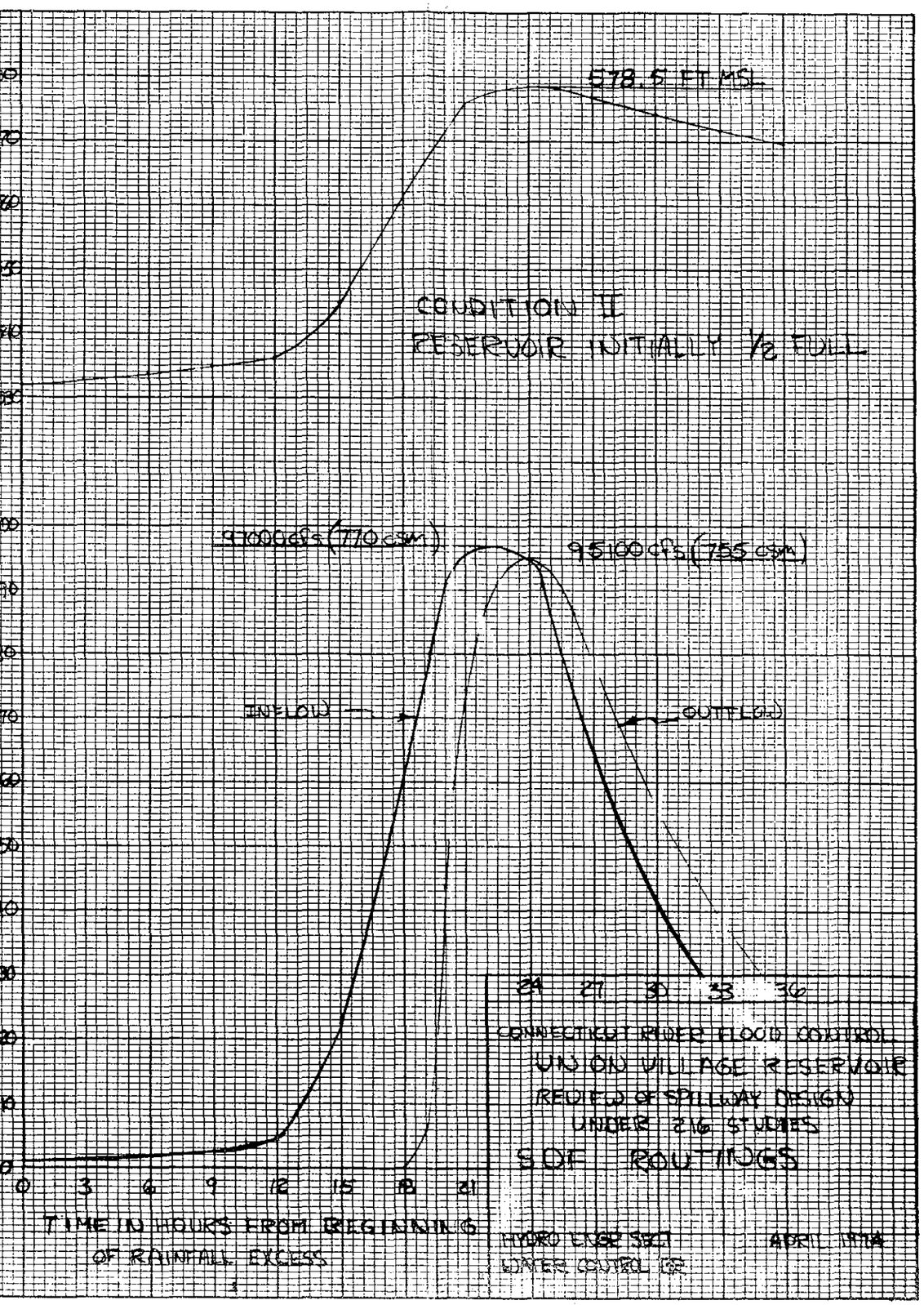
UNION VILLAGE RESERVOIR

REVIEW OF SPILLWAY DESIGN UNDER 216 STUDIES

6-HOUR UNIT HYDROGRAPH

HYDROLOGIC SECT. APRIL 1964
WATER CONTROL BR





CONNECTICUT RIVER FLOOD CONTROL
UNION VILLAGE RESERVOIR
REVIEW OF SPILLWAY DESIGN
UNDER 216 STUDIES
SIDE ROUTINGS

HYDRO ENGR SECT — APRIL 1954
ARMY CONTROL OF

SECTION B

STABILITY ANALYSIS OF STRUCTURES

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS

STABILITY ANALYSIS OF STRUCTURES

UNION VILLAGE DAM

THETFORD, VERMONT

REPORT

CONTRACT NO. DACW33-74-C-0065
Line Item 4

Fay, Spofford & Thorndike, Inc.
Engineers
Boston, Massachusetts

July, 1974

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PART I

GENERAL

I - Section 1 - Project Criteria.

List of recent and updated stability criteria and instructions provided by the Corps of Engineers, New England Division:

Engineering Manuals:

EM 1110-2-2101 - Working Stresses for Structural Design (17 Jan. 1972).
EM 1110-2-2200 - Gravity Dam Design (25 Sept. 1958).
EM 1110-2-2400 - Structural Design of Spillways and Outlet Works (2 Nov. 1964).
EM 1110-2-2501 - Wall Design: Flood Walls (18 June 1962).
EM 1110-2-2502 - Retaining Walls (25 Jan. 1965).

Engineer Technical Letters:

ETL 1110-2-184 - Gravity Dam Design (25 Feb. 1974).
ETL 1110-2-109 - Structural Design for Earthquakes (21 Oct. 1970).

Pertinent Hydraulic Data:

Data for Structural Stability Analysis -

List of design computations and drawings:

(1) Analysis of Design - Dated July 1944
(2) Plans for Construction of Union Village Dam:
    a) One set of construction drawings, Sheet Nos. 1 through 79.
    b) Seventeen photostat copies of various construction drawings noted in a) above indicating final field corrections, dated October 1951.
(3) Plans for Union Village Highway Bridge.

I - Section 2 - Description of the Dam and Operating Condition.

Line Item 4 - Union Village Dam

Union Village Dam is located on the Ompompanoosuc River, 4 miles above its junction with the Connecticut River. It is

one-fourth mile north of Union Village and 11 miles north of White River Junction, Vermont. Completed in June 1950, the dam is of rolled-earthfill with a dumped rock shell. It is 170 feet high and 1,100 feet long.

A concrete spillway, founded on rock and 400 feet long, is located off the right abutment of the dam. The spillway, with its crest elevation 20 feet below that of the dam, would prevent overtopping during passage of a maximum probable flood.

The reservoir, which is operated for flood control purposes, is normally kept empty except for a small operational pool. Control gates in the outlet structure are operated to store floodwaters.

The outlet works include a reinforced concrete intake structure, gate shaft, and outlet apron, all founded on rock. The reinforced concrete-masonry operating house structure is located on top of the gate shaft in rock.

The hydrological data for structural stability, updated and furnished by the Contracting Officer, are as follows:

(a) Full Pool Condition (Reservoir at Spillway Crest):

Energy gradient at spillway (ft. m.s.l.)	- 564.0
Tail-water energy gradient	- 552.0

(b) Design Discharge Condition (Reservoir at SDF Maximum Surcharge Elevation):

Energy gradient at spillway (ft. m.s.l.)	- 578.8
Tail-water energy gradient	- 576.1
Tail-water water surface	- 559.5

I - Section 3 - Criteria for Analysis:

The principal concrete structures and project features analyzed for stability consist of the following:

(a) Operating house
(b) Outlet channel retaining wall
(c) Spillway weir
(d) Spillway retaining walls

Three members of our engineering staff visited the site on May 16, 1974 (copy of memorandum enclosed).

To check sliding resistance of structures under lateral loading, a method different from the original design calculations has been used. This is the shear-friction factor of safety formula, as outlined in the Engineer Technical Letter No. 1110-2-184 of 25 Feb. 1974. The sliding resistance is a function of the angle of internal friction and the unit shearing strength of the foundation material. Where the base of the concrete structure is embedded in rock, the passive resistance of the downstream layer of rock may be utilized in addition to the sliding resistance.

In the analysis of the Union Village Dam structures, the shear-friction safety factor formula used includes all three contributing resistances; namely, the friction, the shearing strength, and the passive reaction where applicable.

For the spillway weir, a minimum shear-friction factor of safety of 4 is required for all conditions of loading when earthquake is not considered. When earthquake is considered, this factor of safety should exceed 2-2/3. Retaining walls on earth require a shear-friction factor of safety of Tan ϕ/1.5.

The resistance to overturning is determined according to current criteria by the location of the resultant of vertical forces at the base. Without seismic forces, the resultant should be located within the middle third. When earthquake is considered, it is acceptable if the resultant stays within the width of the base. For retaining walls founded on rock, the resultant may be outside the middle third of the base if all other conditions are met, i.e., the foundation pressures are within allowable values and the factor of safety against sliding is sufficient.

Because the Union Village Dam is located in Zone 2 (moderate damage), as shown on the Seismic Risk Map of the U.S., included with ETL 1110-2-109, this analysis includes seismic forces as specified for that zone with acceleration of 0.10g.

The seismic forces applied to this stability analysis, in accordance with EM 1110-2-2200 of 25 Sept. 1958, are as follows:

(a) Inertia force $P_{e1} = 0.10W$, acting horizontally through the center of gravity in any direction.

(b) Increase in water pressure by Westergaard's formula, first published in 1933, and expressed in terms of horizontal force P_{e2} and moment M_e at any depth y. Factor C = 51 lbs./ft.^{3} was

used throughout, assuming t = 1 sec. This factor does not change appreciably for the height of structures up to 200 feet.

(c) Dynamic earth pressure in accordance with EM 1110-2-2502 of 25 Jan. 1965, was applied at about two-thirds of the fill height. This pressure is equal to about 20 percent of static lateral earth pressure. The backfill between a sloping wall and a vertical plane through the heel was added to the wall mass for calculation of inertia force P_{el}.

Ice pressure is 5,000 psf x 2 feet = 10,000 pounds per linear foot of structure (refer to EM 1110-2-2200, Section 2-07). It was applied at the spillway weir.

The uplift pressure at any point under a structure is the tail-water pressure plus the pressure measured as an ordinate from tail water to the hydraulic gradient between the upstream and downstream sides. In this analysis, the uplift pressure is considered to act over 100 percent of the base area measured from the upstream edge to the downstream edge.

I - Section 4 - Evaluation of Foundation.

Reference is made to "Analysis of Design," Corps of Engineers, Providence, Rhode Island, 1944.

The subsurface exploration prior to construction consisted of field reconnaissance, sampling of the overburden and rock by means of core borings, test pits, and auger borings.

This investigation included 72 borings and 156 test pits. Twenty-two of these borings were auger borings.

Subsurface investigation indicates that the overburden consisted of fine sand and rock flour and mixtures of sand, gravel and rock flour, together with cobbles and boulders. Bedrock consisted of dark finely laminated schist belonging to phyllite groups of the metamorphic rock. The strata has been strongly deformed resulting in steeply inclined or vertical beds. The rock is slaty and therefore, has the property of splitting in approximately thin even slabs. The predominant strike of the formation is northeast-southwest. The outlet tunnel and appurtenant structures, spillway and

spillway retaining wall were constructed on and in bedrock. The construction plans indicated that sufficient rock was excavated to assure that the spillway and spillway retaining walls were founded on sound rock.

I - Section 5 - Allowable Unit Stresses at Interface of Concrete and Rock.

Allowable stresses at the bonded surface between concrete and rock are assumed to be the same as for 3000 psi concrete or as allowable for the type of rock at the site. EM 1110-2-2101 refers to the ACI Building Code for allowable stresses in concrete with certain modifications. The following allowable stresses are used in this report:

(a) Concrete - Compressive Strength f_c' = 3000 psi at 28 days.

(b) Rock - Finely Laminated Schist (ETL 1110-2-184, 25 Feb. 1974) = average compressive strength of 7000 psi; average shear strength of 1300 psi.

(c) Allowable Bearing Pressure on Rock = 20t/ft.^{2} = 278 psi.

(d) Shear at Interface Between Rock and Concrete = 25 psi. This value is lower than the allowable value based on shear strength of the rock or the allowable shear in unreinforced concrete footings.

These allowable unit stresses may be increased 33-1/3 percent with Group II Loadings, such as wind, ice, or earthquake (EM 1110-2-2101).

PART II

RESULTS OF THE ANALYSIS

II - Section 1 - Operating House.

The operating house structure is part of the outlet works and is constructed above the gate shaft which is a vertical reinforced concrete shaft driven through and founded on sound rock. The operating house substructure is all reinforced concrete and the superstructure is a steel frame masonry enclosed structure. There are two service gate passages. An emergency gate well is in front of each service gate. Upstream from the gates there is a transition section which narrows to the typical horseshoe section in the cast-in-place concrete lined rock conduit.

Access to the control room in the superstructure is from the roadway on top of the dam. The total height of the operating house tower substructure above the gate shaft is 22.5 feet, measured from the top of the control room slab, at Elevation 562, to the operating floor at Elevation 584.5. There is a gate house superstructure 41 feet tall, built on top of the operating floor. In plan, the tower measures 35 feet 2 inches by 42 feet 8 inches.

The structure was analyzed for stability at Elevation 562, top of the operating house basement slab. Loading cases applied are those listed in EM 1110-2-2400, Section 3-07c, entitled, "Stability of Gate Structure at Upstream End." The structure was analyzed for Loading Cases I and II (III through VI not governing), and IA with seismic acceleration of 0.10g for Zone 2. Obviously, noncritical loadings were eliminated by comparison during the analysis. Four loading cases were analyzed; three for stability about the weak axis (perpendicular to the flow), and one for stability about the diagonal axis.

Maximum bending and shear stresses at Elevation 562.0, including seismic forces, are within allowable limits. The intake structure is stable under all of the specified loading cases and no modifications or strengthening is required.

II - Section 2 - Outlet Channel Retaining Wall.

The outlet channel retaining wall is constructed of reinforced concrete and is approximately 60 feet long. The

bottom width varies from 12 feet 0 inch at the conduit exit to 36 feet 0 inch at the downstream end. The invert elevation is level at Elevation 418 feet m.s.l. The floor slab is 2 feet thick and is anchored to the rock base with 1-inch diameter anchor bars. A concrete end sill, 5 feet thick by 10 feet deep, is located at the downstream end of the apron with top of sill at Elevation 519 feet m.s.l. The channel walls for the outlet channel are 1 foot thick concrete lining anchored to the rock by means of 1-inch round anchor bars. The lining is reinforced with 3/4-inch round reinforcement bars spaced 2 feet 0 inch center to center both ways. The base slab is reinforced the same as the wall lining. The height of the concrete lining varies from 14 feet to 8 feet, measured above the channel floor.

The stability analysis of the outlet channel was done in accordance with EM 1110-2-2400, Section 2-08d.

The analysis considers the following cases with the assumption that a slab on rock with drain holes in rock discharging through the floor can reduce the unbalanced hydrostatic uplift by 50 percent:

Case I - Stilling Basin Operating During Spillway Design Flood - Not applicable as no hydraulic jump is developed in the outlet channel.

Case II - Rapid Closure of Gates - No water inside channel, hydrostatic head developed equal to the water level at the top of the channel lining, at a point one-third the channel length from the portal to the base of the channel slab.

The outlet channel was analyzed for uplift pressure with Case II above. The 50 percent reduction in uplift was justified by the gravel drains that were constructed below the channel slab and behind the concrete lining. The slab drains are located perpendicular to the direction of flow, 10 feet on center, and extend up behind the concrete lining. Typically, 2.5-inch black iron pipe drains are located in the slab, 6 feet on center along each drain. Under these conditions, the outlet channel satisfies the stability criteria for the loading cases specified and no further strengthening is required. The outlet channel was also analyzed using 100 percent uplift. The outlet channel would not be stable at this condition. Neither the anchorage system tying the base slab to rock nor the reinforced base slab are capable of anchoring and/or transferring the full uplift load to the concrete lining. Therefore, proper functioning of the drainage system in the outlet channel is necessary for the stability of the channel.

II - Section 3 - Spillway.

The spillway is a low unreinforced concrete weir, curved in plan, embedded in sound schist, with a crest length of 388 feet at Elevation 564.0. The entire channel in the vicinity of the weir is excavated in rock to the desired bottom elevation. The design discharge capacity is 84,900 cfs with a surcharge of 15.0 feet.

A typical cross section of the ogee weir is 23 feet 4-5/8 inches wide and about 20.0 feet high. It consists of fourteen monoliths, twelve of which are approximately 30 feet long each.

Two typical sections were analyzed for stability. Loading cases, in accordance with EM 1110-2-2200, Section 3.01, were applied. The following loading cases were governing:

II - Normal operating with ice pressure.
IV - Flood discharge.
VI - Normal operating with earthquake.

The analysis was based on the following hydrological data:

Loading Case II - Full Pool Condition (Pool at Spillway Crest, No Tail Water). Pool elevation at top of spillway crest 564.0 feet m.s.l. Downstream water surface assumed to be at Elevation 552.0.

Loading Case IV - Design Discharge Condition (Reservoir at SDF Maximum Surcharge Elevation). Energy gradient at spillway 578.8 feet m.s.l., tail-water energy gradient 576.1 feet m.s.l., water surface 559.5 feet m.s.l.

The critical values of the factors of safety against sliding, bearing pressures and location of the resultant for each monolith analyzed are shown in Table 1.

The resultant is within the middle third of the base in all cases analyzed for Section B/29, as shown on Sheet 28 of the original contract drawings, and is representative of two of the fourteen weir monoliths. The overturning stability criteria is not satisfied for Section C/29 under Loading Cases II and IV. To satisfy the overturning stability criteria, remedial measures are recommended for approximately 330 feet of the spillway weir where no anchorage system was provided.

Two schemes for stability remedial measures were analyzed. Cost of either method is similar and both accomplish the stability requirements.

The first method is to add a 2-foot thick by 11-foot high welded wire mesh reinforced concrete wall anchored to the upstream face of the weir by drilled and grouted anchor dowels. The approximate cost of this method is $66,000.

The second method involves the installation of 1-inch diameter steel rod anchors drilled diagonally through the crest of the concrete spillway weir into approximately 14 feet of the rock base. The anchors are 5 feet on center along the crest and are drilled alternately on each side of the crest, one drilled diagonally upstream and the next diagonally downstream in order to engage the vertically cleaved bedrock. The approximate cost of drilling, installing and grouting the rods is $74,000.

The remaining stability requirements are satisfied for all of the loading cases analyzed for Section C/29 and foundation pressures for all of the cases are within the allowable bearing pressure for the rock.

TABLE 1

SPILLWAY WEIR

Weir Section	Loading Case	Location of Resultant In Middle Third	Resultant In Base	Percent Base In Bearing	Resistance to Sliding Factor of Safety (*)	Bearing Pressures on Rock Maximum Tons/S.F.	Minimum Tons/S.F.
B-B/29	II	Yes	-	100	9.1	0.45	0.45
	IV	Yes	-	100	7.5	0.35	0.18
	VI	Yes	-	100	10.0	0.69	0.21
C-C/29	II	No	Yes	93	7.9	1.02	-
	IV	No	Yes	71	7.8	0.68	-
	VI	Yes	-	100	11.4	0.50	0.35

*Factor of safety is for bond shear value of 25 psi and $\phi = 30^{o}$.

II - Section 4 - Spillway Walls.

The spillway retaining wall is a gravity section founded on rock and located at the east side of the spillway. The wall is approximately 270 feet long with construction joints 30 feet on center. The upstream portion of this wall is approximately 54 feet high and 37 feet wide at the base. The downstream portion of the wall, due to the increasing rock elevation, is of varying height throughout with a portion of the wall built on a rock berm adjacent to the spillway chute rock cut.

The maximum wall height is approximately 50 feet opposite the spillway crest with a base width of 34 feet and reduces to zero height when the top of wall and top of rock elevation coincides 190 feet downstream of the spillway crest.

The retaining wall was analyzed in accordance with EM 1110-2-2502 for active earth pressures, disregarding fill in front of the wall. Remedial measures for stability of the walls are necessary if the resultant falls outside the middle third or if the walls do not satisfy other given criteria. Loading cases listed below were based on design criteria given in EM 1110-2-2400 for approach channel walls.

Loading Cases:

Upstream Wall:

I - Normal operating condition, water level in channel to top of spillway, Elevation 564.0, backfill impervious submerged to same elevation.

I-1 - Normal operating condition, channel empty, backfill submerged up to Elevation 564.0.

II - Sudden drawdown in channel water level to bottom of channel, backfill submerged to maximum flood Elevation 578.0±.

III - Maximum flood condition, water level in channel to Elevation 578.8, and backfill submerged up to Elevation 578.8.

IA & I-1A - I or I-1 with earthquake.

Downstream Wall:

I - Channel empty, backfill to top of wall.

II - Floodwater stage, tail-water Elevation 559.5 (or top of wall if lower, no water in backfill).

IA - I with earthquake.

One section of the wall on the upstream side and two sections on the downstream side of the weir were analyzed for stability. The critical values of the factors of safety against sliding, location of resultant, and foundation pressures are shown in Table 2.

The overturning stability criteria is not satisfied for Section F/29 under Loading Case II. The above section is shown on Sheet 30 of the original contract drawings. To satisfy the overturning criteria, remedial measures are recommended for the upstream portion of the wall.

An anchorage system with deadman is recommended for this wall approximately 60 feet in length. The anchorage system is to be designed so that the resultant will be located within the middle third of the wall. This system consists of horizontal tie rods approximately 8 feet on center and located about 5 feet from the top of the wall, inserted through holes drilled in the wall and connected to a deadman anchor located approximately 90 feet back from the face of wall. The approximate cost of this construction is $25,000.

Additional mass concrete added to the back face of the inclined wall scheme and post-tensioned high strength steel anchors scheme were also considered for the upstream wall but were found to be impractical for the loading involved.

TABLE 2

SPILLWAY WALL

Wall Section	Loading Case	Location of Resultant In Middle Third	Location of Resultant In Base	Percent Base in Bearing	Resistance to Sliding Factor of Safety (*)	Bearing Pressures on Rock Maximum Tons/S.F.	Bearing Pressures on Rock Minimum Tons/S.F.
F/29	I	Yes	-	100	8.5	2.32	1.68
	I-1	Yes	-	100	4.9	3.63	0.37
	I-1A	No	Yes	85	3.0	5.58	-
	II	No	Yes	88	3.7	4.35	-
	III	Yes	-	100	9.0	2.67	0.94
K/29	I	Yes	-	100	3.1	2.95	0.08
	II	Yes	-	100	7.6	3.07	0.44
	I-1	No	Yes	54	2.2	5.65	-
L/29	I	Yes	-	100	18.6	1.28	-
	II	Yes	-	100	65	1.00	0.54
	I-1	No	Yes	86	9.3	2.02	-

*Factor of safety is for bond shear value of 25 psi and tan ϕ = 0.5

CONCLUSION

The operating house and outlet channel retaining wall satisfy, in all cases, the requirements of the new criteria for stability and no modifications or strengthening is required.

The spillway weir and spillway retaining walls satisfy this criteria except that the location of the resultant in the middle third criteria under some of the various cases analyzed is not satisfied. The estimated cost and recommended remedial measures, consisting of rock anchors, tie rod anchorage or additional mass concrete, to these structures are as follows:

Spillway Weir:

Rock anchors at 5 feet on center along crest staggered or mass concrete, 2 feet thick by 11 feet high with welded wire mesh	- $74,000

Spillway Walls:

Tie rod anchorage 60 feet of wall - upstream of weir	- 25,000
	$99,000

MEMORANDUM

Site Visit to Union Village Dam
Thetford, Vermont
May 16, 1974

The writer and Messrs. Stoller and Cosimini were shown around by Mr. Treasher, project manager. It was 60 degrees, sunny and mild. We visually inspected and took photographs of the following concrete structures:

1. Operating House - Gates raised to the 3-foot position, no head buildup. Concrete substructure surfaces appear to be in good condition inside and outside. Masonry and steel frame superstructure appear to be in good condition. All interior steel surfaces painted, concrete interior surface, including stairs, also painted and housekeeping excellent.

2. Outlet Apron - Moderate flow leaving tunnel (estimate pipe about one-eighth full). concrete walls appear in good condition. Drain through southeast corner of stilling basin wall flowing about 10 gallons per minute. About one foot depth of water in outlet channel as read on gauge.

3. Spillway Weir and Retaining Walls - Surface spalling occurs on the downstream face of the spillway at the intersection of the vertical and horizontal construction joints. Depth of spalling at the most damaged area is approximately 2 inches deep and tapers back to zero, approximately 18 to 24 inches away along the horizontal joint. This horizontal joint, 8 feet below the crest, is also surface spalling along its length at various locations and appears as if a previously placed mortar patch is lifting off. In general, the spillway weir concrete surface appears in good condition except for minor surface spalling as noted.

   The concrete retaining walls appear to be in very good condition. Groundwater flow was noted discharging slowly from the downstream retaining wall drains.

We inspected the rock outcrops at the above noted structures and field observation indicates that the rock in the area is a dark finely laminated schist with mica and quartz intrusion in places. This rock belongs to the phyllite group of metamorphic rocks. These outcrops indicate that the strata has been strongly deformed resulting in steeply inclined or vertical beds. The rock is slaty and therefore, has the property of splitting in approximately thin even slabs. Observations indicate that the rock is generally stable on a vertical slope. The writer observed failures which occurred over the years, minor in nature, where water was present. In these areas, frost action has opened cracks along the cleavage planes and in most cases caused the exposed rock to fail.

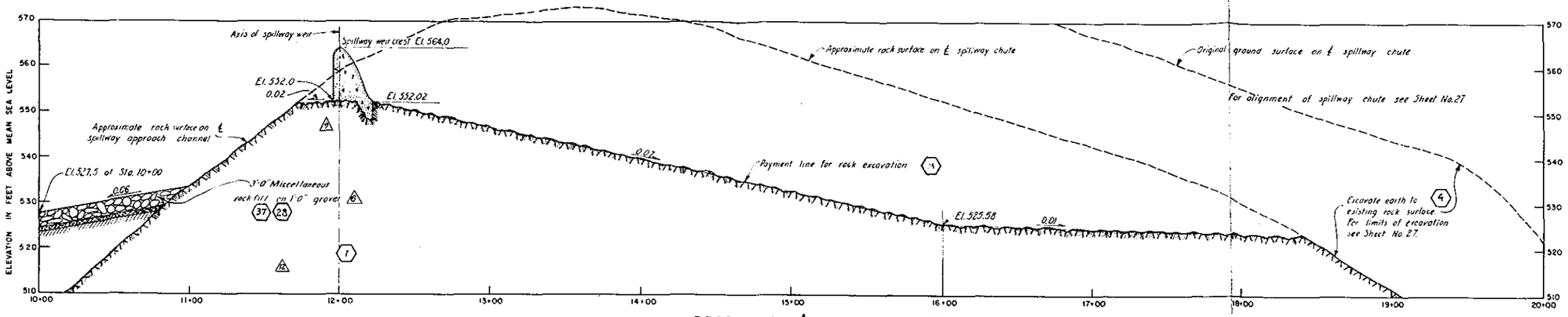
We did not notice any variances to conditions indicated on drawings and descriptions furnished to us that would affect the stability analysis of the structures. However, the approximate vertical slope of the rock strata will affect any remedial measures utilizing rock anchors.

Jurgis Gimbutas

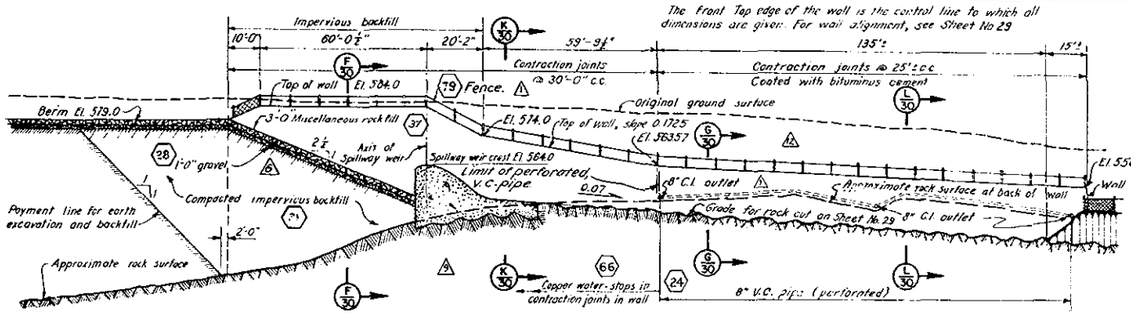
JG;ej
EN-4

WAR DEPARTMENT

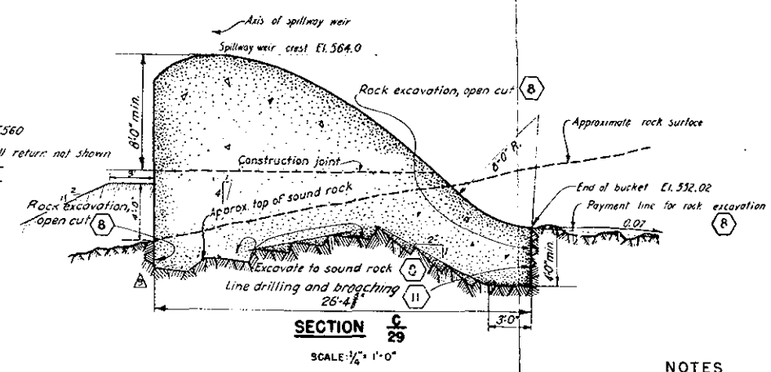
CORPS OF ENGINEERS, U. S. ARMY



PROFILE ON ℄ SPILLWAY CHUTE

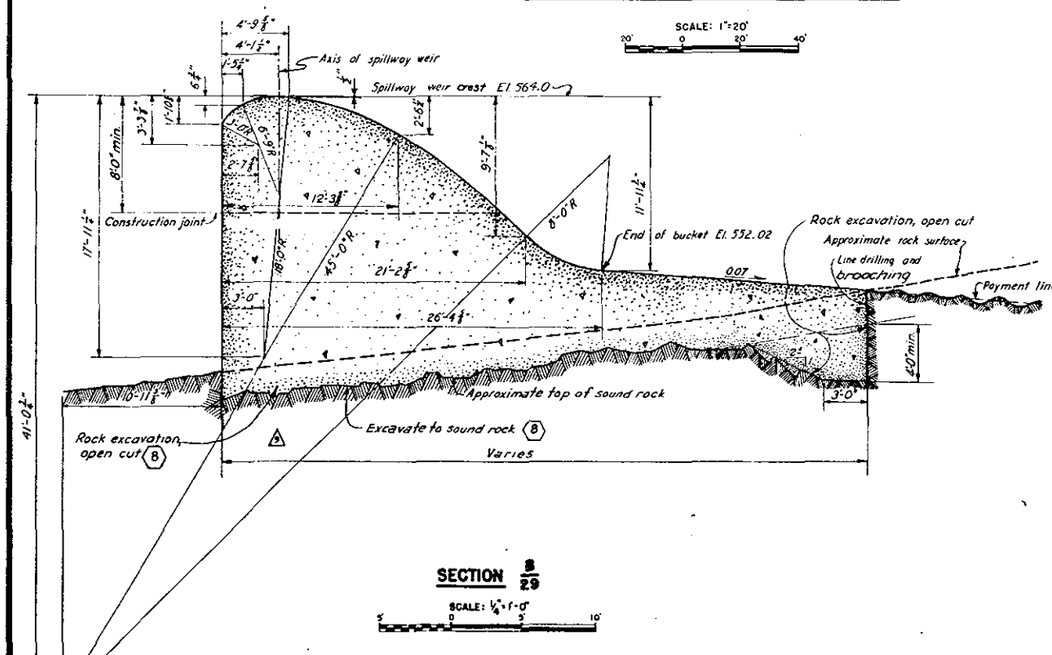


ELEVATION— RETAINING WALL DEVELOPED



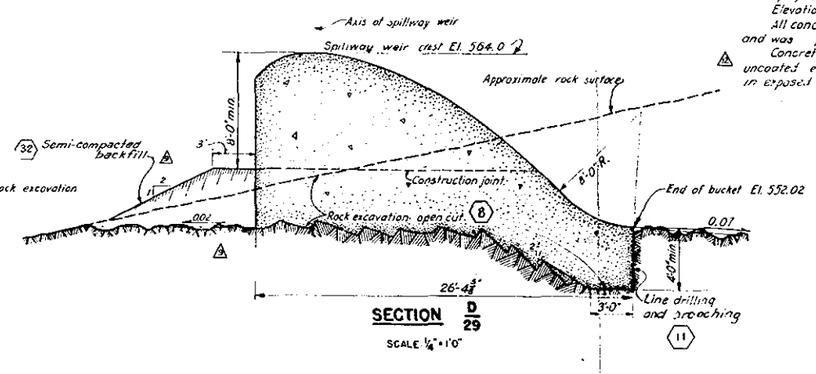
SECTION C/29

SCALE: ¼" = 1'-0"



SECTION E/29

SCALE: ½" = 1'-0"



SECTION D/29

SCALE ¼" = 1'-0"

NOTES

Figures in hexagons indicate item numbers under which payment was made.

Elevations refer to Mean Sea Level Datum.

All concrete shown on this sheet is Class "B" and was paid for under Item No. 51

Concrete surfaces at contraction joints are uncoated except as noted, and were V-stripped in exposed faces of concrete. See detail on Sheet No. 30

KEY	DATE	REVISION (indicated by △)	REVISED BY	CK BY	AP BY
△	5 Oct 49	Spillway retaining wall and drainage revised			
△	" " 49	Key & grouting eliminated			
△	2 Sept 48	Minor alterations permitting construction for riprap			
△	5 Apr. 46	Hole and weepholes removed			

CONNECTICUT RIVER FLOOD CONTROL

UNION VILLAGE DAM

SPILLWAY DETAILS

OMPOMPANOOSUC RIVER VERMONT

IN 66 SHEETS SCALE AS SHOWN SHEET NO. 28

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., JULY 1944

SUBMITTED: G. D. Hudson, SENIOR ENGINEER, PROJECT ENGINEER

APPROVAL RECOMMENDED: Z. B. Burns, HEAD, ENGINEERING DIV.

APPROVED: [illegible], COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

PREPARED: G. D. Hudson, PROJECT Unit NO. 2

DRAWN: D.C. TRACED: V.S.C. CHECKED: G.H.M.

FILE NO. CT-1-1762

PLATE 22

APPENDIX 2

PERTINENT CORRESPONDENCE

TABLE OF CONTENTS

Letters	Page
New England River Basins Commission - 14 November 1975	PC-1
Vermont Natural Resources Council - 17 November 1975	PC-3
Corps of Engineers - 5 December 1975	PC-4
Vermont Environmental Board - 18 November 1975	PC-5
U.S. Dept of Agriculture, SCS - 19 November 1975	PC-6
Vermont Dept of Highways - 28 November 1975	PC-7
National Park Service - 8 December 1975	PC-8
Town of Thetford - 15 December 1975	PC-10
Corps of Engineers - 19 January 1976	PC-11
Vermont Dept of Water Resources - 16 December 1975	PC-15
U.S. Fish and Wildlife Service - 19 December 1975	PC-16
U.S. Bureau of Outdoor Recreation - 12 January 1976	PC-19

NEW ENGLAND RIVER BASINS COMMISSION

NERBC

55 COURT STREET • BOSTON, MASSACHUSETTS 02108
PHONE (617) 223-6244

November 14, 1975

Joseph L. Ignazio
Chief, Planning Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Ignazio:

This will reply to your letter of November 10 requesting comments concerning the Corps' current Section 216 preliminary investigation of the Union Village flood control project in the Connecticut River Basin.

As you know, the Commission has taken a position on the modification of this and other existing Corps flood control projects in its findings and recommendations on the Coordinating Committee's 1980 Connecticut River Basin plan. The Commission's recommendations, supplemented by technical reports prepared for the Connecticut River Supplemental Study, will be the basis for my comments.

The Commission endorsed the Coordinating Committee's recommendation for modification of Union Village flood control reservoir, to include uses for recreation, fish and wildlife enhancement and water supply, subject to 1) satisfactory completion of an environmental impact evaluation pursuant to the National Environmental Policy Act and 2) subject to improvement of water quality on the West Branch of the Ompompanoosuc. The plan also recommends that existing dry bed flood control reservoirs be studied for possible agricultural and recreational use during periods when they are normally dry. (pp. 95-96)

It is understood that the Corps' current investigation will focus attention on the need for reformulation of project use for other purposes, such as additional flood control, water supply, recreation, fish and wildlife resources and other water related items for improving the quality of the environment. It is further understood that the project area contains a small day-use recreational area with facilities for swimming and picnicking and that sightseeing, fishing, hunting and snowmobiling are major activities at this project.

The current investigation appears to be in keeping with the intent of the policy established for this project by the Coordinating Committee and by the Commission. To be fully consistent, the investigation should take into

consideration the schedule for water quality improvement on the West Branch and adjust the sequence of any recreational modifications as appropriate. The possibility of agricultural use when the project is normally dry should also be considered.

As you know, the NERBC Connecticut River Supplemental Study has examined the impacts of proposed flood control reservoirs - including the dry-bed Meadow project - on fish and wildlife resources, recreational potential, cultural sites and water quality. These analyses were intended to provide an improved information base for evaluations of various environmental alterations; they have identified environmental effects that should be taken into consideration specifically in dry-bed reservoir planning. Since the Union Village reservoir modification proposal is conditioned on an environmental impact evaluation, the Section 216 investigation should include these considerations.

Thank you for the opportunity to comment.

Yours truly,

Frank Gregg
Chairman

FG:ht
cc: B. Johnson - Vt.
M. Evans - USFWS
E. Nichols - BOR
J. Raftery - NPS
W. Newman - EPA
Vt. CRBP CAG/SAG

VERMONT NATURAL RESOURCES
COUNCIL

November 17, 1975

Mr. Joseph L. Ignazio, Chief
Planning Division
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Dear Mr. Ignazio:

Thank you for your letter of November 10 concerning the study of the Union Village Dam installation.

I do not have any specific comments concerning your project but I have become aware of the serious reservoir bank erosion problem on the Hartland Flood Control Reservoir and I wonder if similar problems exist at the Union Village Dam?

The Hartland reservoir, as I understand it, suffers from erosion and stumping of the banks that is so severe in places that the Corps has offered to purchase shoreline property just to accommodate this erosion. This seems like a terrible waste of soil resources and the resulting siltation must reduce the reservoir's capacity over the years. Is the Corps attempting to study this problem or otherwise solve it? Perhaps you could help me better understand the situation. I would appreciate any information you could provide me.

Sincerely yours,

Seward Weber
Executive Director

SW:km

26 STATE STREET, MONTPELIER, VERMONT 05602 TELEPHONE (802) 223-2328

Mr. Canavan/cm/305/306

NEDOD-R

5 December 1975

Mr. Seward Weber
Executive Director
Vermont Natural Resources Council
26 State Street
Montpelier, VT 05602

Dear Mr. Weber:

This letter refers to your 17 November 1975 letter to Mr. Ignazio, concerning Union Village Dam and North Hartland Lake.

With respect to the soil slumping problem at North Hartland Lake, plans are underway to evaluate various methods of soil stabilization at three sites, including North Hartland Lake, in fiscal year 1976. As indicated to you in an earlier letter on 29 August 1974, we expect results from this prototype program to indicate the best method of rehabilitating areas of soil slumping at reservoirs.

Erosion at Union Village Dam is minimal and limited to only a few small sites scattered throughout the reservoir. No corrective action is considered necessary at this time. We will continue to monitor these areas and make plans to stabilize and revegetate them at the appropriate time.

We appreciate your interest in Union Village Dam and North Hartland Lake. Please feel free to contact me again if we can be of assistance to you in the future.

Sincerely yours,

V. L. ANDRELIUNAS
Chief, Operations Division

CF: Basin Manager, UCRB, w/cpy ltr
Planning Division (Mr. Ignazio) w/cpy ltr
North Hartland Lake, w/cpy ltr
Union Village Dam, w/cpy ltr
Opers Div File

State of Vermont

AGENCY OF ENVIRONMENTAL CONSERVATION
Montpelier, Vermont 05602

ENVIRONMENTAL BOARD
Schuyler Jackson, Chairman
828-3309

Department of Fish and Game
Department of Forests and Parks
Department of Water Resources
Environmental Board
Division of Environmental Protection
Division of Recreation
Division of Planning
Natural Resources Conservation Council

November 18, 1975

Mr. Joseph L. Ignazio
Chief, Planning Division
Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: NEDPL-P

Dear Mr. Ignazio:

Thank you for your letter of November 10 concerning the reevaluation of the Union Village Dam project.

I have no comments concerning this project and trust that similar requests have been forwarded the Agency of Environmental Conservation.

Yours very truly,

Schuyler Jackson
Chairman

SJ/h

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
1 Burlington Sq., Suite 205, Burlington, Vermont 05401

November 19, 1975

Mr. Joseph L. Ignazio
Chief, Planning Division
Department of the Army
New England Division, Corps of
Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Ignazio:

This is in response to your letter of November 10, 1975 regarding your preliminary investigation of the completed Union Village Dam project.

Based on our limited knowledge of this project we are not aware of any need for reformulation of this project.

We appreciate the opportunity to comment.

Sincerely,

Robert R. Shaw acting

Craig M. Right
State Conservationist

STATE OF VERMONT
DEPARTMENT OF HIGHWAYS
MONTPELIER
05602

November 28, 1975

Mr. Joseph L. Ignazio
Chief, Planning Division
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Attention: NEDPL-P

Dear Mr. Ignazio:

Thank you for notifying us of your preliminary investigations of the Union Village Dam project. At this time, we do not have any comments or suggestions regarding modifications or changes to the existing structure or overall project.

We do not believe that any realistic alterations to the dam could affect our highways or bridges in the area. However, we would like to be notified of any changes your studies show might be feasible.

Sincerely,

John T. Gray
Commissioner

United States Department of the Interior

NATIONAL PARK SERVICE

NORTH ATLANTIC REGION
150 CAUSEWAY STREET
BOSTON, MA. 02114

IN REPLY REFER TO:

L--7619-NAR-(CE)
NEDPL-P (COE-NE Div.)
Union Village Dam

December 8, 1975

Mr. Joseph L. Ignazio, Chief
Planning Division
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Ignazio:

This is in response to your letter of 10 November concerning your studies of current and economic conditions of and about the existing Union Village (Vermont) Dam project.

We would understand this study will allow you to determine the need for project reformulation to provide for additional flood control, water supply, recreation, fish and wildlife resources and other water related items.

While we cannot offer any specific base data to substantiate the need for reformulation of the project, we do want to convey our concern for the protection of cultural resources should your study call for any increase of or addition to project items as they now exist.

We would encourage you to maintain a check of the National Register of Historic Places and make contact with the State Historic Preservation Officer to assure no oversight of sites on or being considered for inclusion in that listing of historic places.

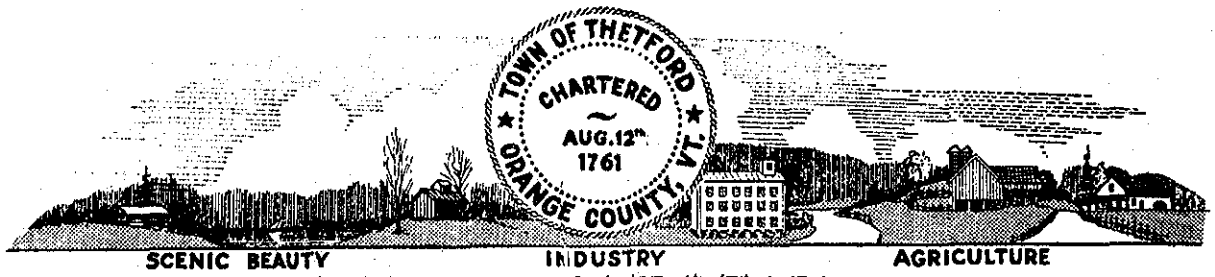
It is quite possible that Dr. Bert Salwin, an archeologist from New York, looked into this project site during its planning phase prior to 1950. For further site investigation concerning archeological values, you should contact Dr. Salwin, or Dr. Margery Hornerkamp, Department of Anthropology, University of Vermont, Burlington, Vermont 05401.

We would note your letter was addressed to our Mid-Atlantic Regional Office in Philadelphia. Please be advised that Vermont, the other five New England states, New York and New Jersey comprise our North Atlantic Region headquartered here in Boston.

We appreciate this opportunity to be aware of and comment on this study and will be pleased to be kept informed of its progress.

Sincerely yours,

Jerry D. Wagers
Regional Director



TOWN of THETFORD

THETFORD CENTER, VERMONT

December 15, 1975

Joseph L. Ignazio
Chief Planning Division, Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Sir:

In answer to yours of November 10, 1975 regarding the Union Village Dam Reservoir Area we would like to make the following observations.

Thetford appreciates the development of recreational and environmental facilities. It is in regard to the former that we have concern.

Broken glass in the sand on the beach areas is a concern.

Quoting from an article in the Bradford Opinion:

> "There are incidents of other events taking place which have resulted in official complaints to town officials. Yet, because this is a federal reservations, local law enforcement people have no authority."
> A federal ranger patrols on occasion. Thetford officials feel that added control is needed."

Family groups still use the area to a certain extent, although the number has lessened. There have been many activities of questionable nature that have not resulted in an official type complaint being registered.

One local radio station occassionally comments that in good weather that "it is a great day for skinney dipping behind U.V.D." This seems to attract not only swimmers, but persons interested in public nudity and allied activities.

We realize that this is not a unique situation where federal properties are concerned. This being located, as it is, in the center of Thetford has become of some real concern to the selectmen.

George P. Thomas
Virginia S. Babcock

Very truly yours,
Thetford Board of Selectmen

PC-10

NEDOD-R Recreational se of Union Village Reservoir

XX

THRU: Provost Marshal Chief, Operations Division 19 January 1976
Mr. Crawford/cm/ 305/ 306

TO: Division Engineer

1. This responds to your request for comments on the 15 December 1975 reply of the Thetford, VT selectmen to Planning Division's 10 November 1975 letter on the preliminary Section 216 study of Union Village Dam. It also records the actions that we have taken since receiving a copy of the town's letter.

2. We have discussed the matter of recreational use of this reservoir in detail with our field personnel and met with the selectmen on 5 January 1976. Although visitor control problems surfaced in 1972, our conclusion is that the situation has improved and that, with the exception of thefts (discussed later), public use of the area in 1975 was free of any serious problems. The selectmen do not dispute this. They explained that, as we expected, the concerns described in their letter were intended to represent problems that came to their attention at various times in the past and that, in fact, they received very few complaints during 1975. They appreciated our meeting with them; they were unaware of many of our efforts in the reservoir (ranger patrols, etc.) during the past two years and expressed overall concurrence with the directions that our management of this area is taking.

3. More details on our meeting with the selectmen and related matters follow. We plan no further action on this subject at this time, other than proceeding with our plans for further improvements in visitor control and contacting the state police to insure that they realize their authority.

4. Prior to meeting with the selectmen we obtained the attached copy of the news article that their letter quoted. It is essentially a mixture of Planning Division's letter and remarks from selectmen (made before our meeting with them).

5. The problems that surfaced in 1972 involved two activities - nude bathing and speeding. Residents of Union Village were concerned primarily about speeding along their main street. This street ends at the entrance to the dam and the residents felt that inadequate law enforcement at the dam and reservoir was causing the problem. We met separately during that period with a representative of the local residents, the state police, and the Thetford selectment (Union Village is a part of Thetford). In addition, we corresponded with U.S. Representative Mallary. We explained to all involved that we depend on local and state police for law enforcement and alerted the town to several suggestions from the state police for correcting the speeding problem (lowering speed limit, residents witnessing speeding violations could file complaints, etc.).

6. With respect to nude bathing, we reiterated our dependence on local and state police and noted that the enforcement problem was complicated by the fact that no state or local ordinance specifically covering this activity existed. The State

Attorney General's office expressed interest in this aspect and indicated that they intended to file legislation on nude bathing. Since that time, such a law has been passed in Vermont. In addition to restrictions on visibility from highways, etc., the law states that nude bathers can be prosecuted, but only if a complaint is registered by others.

7. Since 1972, the only significant or unusual visitor control problem that came to our attention involved thefts of personal property from visitors' vehicles. This problem first surfaced in 1974 and intensified in 1975. The recreational facilities at this reservoir consist of a beach and several small picnic areas located at intermittent points over a distance of several miles along the reservoir's access road. The steep topography of the reservoir and the changing grade and alignment of the road tend to seclude these areas, complicating supervision and facilitating thefts. Also, the parking areas are not visible from the beach or picnic sites. Patrols by the two basin rangers were increased in 1975, to the extent that overtime and patrol demands at the other six basin reservoirs permitted. During the coming summer recreation season, visitors will be advised through signs and the media to safeguard valuables. Also, we plan to assign a uniformed, temporary park technician to the area for the full season. This problem and our plans have been coordinated with the Provost Marshal.

8. Aside from the thefts, our field personnel feel that overall visitor control has improved in recent years. They reported a very noticeable improvement in 1975 and attribute this in large part to the periodic visibility of the rangers since May 1974. Nude bathers have moved to remote portions of the reservoir, away from other recreationists. In 1975, our rangers encountered only one nude bathing incident at the developed beach. Also, our personnel have heard the radio announcement referred to in the town's letter, but report that the actual wording of the announcement was: it is a great day for sun bathing at UVD .

9. Our 5 January 1976 meeting with the selectmen was held in the evening, at their offices. Representing this office were Messrs. Crawford, Morse (basin manager), Spaulding (ranger) and Thresher (project manager); selectmen George Stowell, Richard Hauger and Virginia Babcock represented the town.

10. My representatives described our recreation-resources management efforts, including the role of the rangers. The selectmen were advised that the rangers can enforce Corps rules and regulations but that we still must depend on the police, who have concurrent jurisdiction, for enforcement of state and local laws. The selectmen were somewhat surprised at our interest in the area and the extent of our management activity. It was clear that their familiarity with the operation and public use of the area over at least the past two years was limited. They admitted that their letter was based essentially on past events and should not be interpreted as representative of the current situation. In fact, despite several attempts by my representatives to elicit information from them, the selectmen could offer very little evidence of problems. Therefore, much of the meeting was spent updating the selectmen. They displaye

considerable interest in Mr. Spaulding's first-hand description of public use of the area during the past two years. They indicated that they have no reason to doubt our contentions that overall control of the area has improved and that the number of families visiting the area increased in 1975. They feel the periodic presence of a ranger in uniform should be helpful as a deterrent in visitor control.

11. The meeting gave us a far different impression of the attitudes (and knowledge) of the selectmen regarding this area than that presented by their letter. The meeting atmosphere was one of reason and cooperation and they seemed to be primarily concerned with merely keeping abreast of the situation, as representatives of the town. They expressed general concurrence with our management approach and we encouraged them to alert us to any future problems that come to their attention. We stressed that our objective is to maintain a family atmosphere at all recreation areas we manage and that we want to do all that we can to assure that the reservoir is viewed as an asset to the town.

12. Other points discussed during the meeting included the following:

a. Their letter's comment on broken glass at the beach was apparently prompted by a complaint to Ms. Babcock by a town resident. Our personnel have noticed some evidence of night beer parties and resulting broken glass. We explained that the project personnel patrol the area daily on weekdays during the summer season and that any litter, including glass on the beach is removed immediately. The resident who complained was probably in the area between patrols (or during a weekend, between ranger patrols). We promised, though, that our personnel will give extra attention to this in 1976, including glass in underwater areas. Assignment of a park technician to this area should help us reduce the potential for problems such as this. Nightly closings of the reservoir, as discussed below, should help in eliminating the cause.

b. Thetford Center Road, which runs roughly parallel to the river, serves as the access for all of the developed recreation areas at this reservoir. This road could be barricaded at darkness each night on both ends during the summer, by the park technician. All agreed that this should discourage night parties in the reservoir. A barricade is already available at the northern end. The southern barricade would most likely be positioned at the dam's administration area, thereby allowing turn around room for vehicles. The selectmen expressed agreement with this proposal. Some local residents use this road to reach other town areas, but alternate roads that areavailable to them are paved and considered much more suitable for through traffic than the reservoir road, which is gravel. The reservoir road is left unplowed and, as a result, the residents are already accustomed to using the alternate roads during the winter. For these reasons, the selectmen feel that these individuals would accept night closures during the summer, if they are made aware of the reason. We have since decided that the basin manager should write the selectmen in advance, when the starting date for the night closures is set, so that they may respond to any inquiries they might receive.

c. The selectmen suspect that the state trooper whose jurisdiction includes Union Village may be unfamiliar with his authority on the reservoir, since he is

NEDCD-R 19 January 1976
SUBJECT: Recreational Use of Union Village Reservoir

new to the position. We promised to review his authority with him. The Provost Marshal has agreed to do this. The selectmen were given a copy of the Division Counsel's paper on concurrent jurisdiction, for their town constable. They were asked to contact us, should he have any questions.

1 Incl
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ANDRUKIUMAS

CF: Basin Manager, UCRB (2), w/cpy of article
Planning Division, w/cpy of article
Provost Marshal, w/cpy of article
Opers Div File (Union Village)

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State of Vermont

AGENCY OF ENVIRONMENTAL CONSERVATION

Department of Fish and Game
Department of Forests, Parks, and Recreation
Department of Water Resources
Environmental Board
Division of Environmental Engineering
Division of Environmental Protection
Natural Resources Conservation Council

Montpelier, Vermont 05602

DEPARTMENT OF WATER RESOURCES

December 16, 1975

Mr. Joseph L. Ignazio
Chief, Planning Division
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: NEDPL-P

Dear Mr. Ignazio:

This is in reply to your letter of November 10 requesting comments concerning the Corps' current 216 preliminary investigation of the Union Village flood control project.

We are still concerned with satisfying the need for additional water surface areas in this region. There are no state beach facilities anywhere in the vicinity. Presuming the water quality problems do not prove to be prohibitive, an expanded facility should be welcome. Representatives of the towns affected should be consulted for their views on the project.

We would recommend that water quality in the West Branch be thoroughly investigated and other uses such as water supply and hydro power be considered.

The Vermont Agency of Environmental Conservation should be kept up to date on the investigation through this Department. We would be glad to assist in the investigation in any way and wish to thank you for the opportunity to comment.

Sincerely,

Gordon R. Pyper

GORDON R. PYPER, P.E.
Commissioner

GRP:JEC:j

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Division of Ecological Services
P. O. Box 1518
55 Pleasant Street
Concord, NH 03301

December 19, 1975

Division Engineer
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Dear Sir:

Enclosed is our report regarding preliminary investigations for improvements at Union Village Dam, located at Union Village, Orange County, Vermont. This report was prepared in response to Mr. Ignazio's letter dated November 10, 1975.

We appreciate the opportunity to comment on this project and look forward to working with your agency as such projects come up for review.

Sincerely yours,

Melvin R. Evans

Melvin R. Evans
Area Office Supervisor, NEAO

DHR/bmk:MRE

UNION VILLAGE DAM, UNION VILLAGE, VERMONT

Report of the U.S. Fish and Wildlife Service to determine the need for improved fish and wildlife habitat, resources and related factors in the project area.

Improvements are being considered by the Corps of Engineers, New England Division, under authority of Section 216 of the 1970 Flood Control Act (Title II of Public Law 91-611) according to Mr. Ignazio's letter of November 10, 1975. The U.S. Fish and Wildlife Service last reported on this project on April 19, 1956. This report has been prepared under authority of the Fish and Wildlife Coordination Act (48 Stat., 401 as amended; 16 U.S.C. 661 et seq.), in coordination with the Vermont Department of Fish and Game, and has their concurrence.

Union Village Dam is located on the Ompompanoosuc River at Union Village, Orange County, in east-central Vermont, near the New Hampshire (Connecticut River) border. Construction of the project was completed in June 1950 and the purpose of the project is flood control.

A total of 1,272 acres behind the dam is maintained by your agency providing habitat for white tailed deer, grey squirrel, snowshoe hare, ruffed grouse, woodcock and numerous furbearers. The forested slopes along the east side of the Ompompanoosuc River at the dam serves as a valuable deer wintering area, while dense underbrush and grass along the river's edge provdies food for that species during the warmer months. Hunting pressure in the area is considered to be moderate.

Fishery resources in the area are severely limited by heavy metals (copper, lead, zinc) from an abandoned copper mine slag dump located in the West Branch, Ompompanoosuc. Species expected in the vicinity of the dam would include black nosed dace, long nosed dace, white sucker, fall fish, golden shiner, common shiner, bullhead, rock bass and sculpin with

brook trout and brown trout in the East Branch. There have been no recent studies regarding fishing pressure in the area, however, there are no known major fisheries in the immediate vicinity of the dam.

Presently, boating, swimming and fishing opportunities in the general area of Union Village appears to be adequate. The dam is located within four miles of the Connecticut River, which supports a large, underutilized warm water fishery. In addition, there are three large lakes within a 15 mile radius of the dam which also provide good warm water fishing, boating and swimming opportunities.

Therefore, in view of the problem of poor water quality and the apparent ample opportunity for water-related activities in the area, the U.S. Fish and Wildlife Service recommends that the dam and reservoir area be maintained in its present state. If at some later date it is determined that the demand for a permanent pool or other requirements make modifications desirable, this Service will advise you.

We appreciate the opportunity to review this project.

United States Department of the Interior
BUREAU OF OUTDOOR RECREATION
NORTHEAST REGIONAL OFFICE
Federal Building - Room 9310
600 ARCH STREET
Philadelphia, Pennsylvania 19106

IN REPLY REFER TO:

JAN 12 1976

Mr. Joseph L. Ignazio
Chief, Planning Division
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02154

Dear Mr. Ignazio:

This is in reply to your request for information and comments on the review of project operations of the completed Union Village Dam.

With regard to recreation, we reviewed the current Vermont Statewide Comprehensive Outdoor Recreation Plan (SCORP) published in 1973 to determine recreation needs, priorities, and opportunities identified in the vicinity of the Union Village Dam and on the Ompompanoosuc River. The SCORP identifies the section of the river above Union Village as being an "outstanding stretch of river" and having a potential for swimming. Union Village Dam is located in Vermont State Planning District III, an area of 1,300 square miles, having very few lakes - only 21 with a total of 1,800 surface acres. Because of the lack of lakes and ponds for water oriented recreation, the region's primary resources are its rivers and streams. The SCORP states that the region's major needs are for (1) acquisition of lands for water oriented recreation; (2) acquisition of lands adjacent to existing holdings and water bodies with high scenic and recreational potential; (3) development of water-oriented day use facilities for regional use; (4) acquisition of new scenic and natural areas for multi-purpose recreation; and (5) development of trails systems.

More recent information on outdoor recreation may be obtained from:

Mr. Edward J. Koeneman
Director, Division of Planning
Agency of Environmental Conservation
Montpelier, Vermont 05602

This Regional Office of the Bureau of Outdoor Recreation participated in the Connecticut River Supplemental Flood Management Study. Our involvement in the Study did not include any recreation investigation of the Union Village Dam, although regional personnel did visit the site during the course of their general field investigations. No conclusions were drawn at that time about the project's current or potential level of recreation use. We would be willing to assist your office in efforts to obtain a non-federal sponsor for the project and in reviewing plans for increased recreation use of the facility.

We received a copy of the comments which the New England River Basins Commission (NERBC) gave you on this potential Section 216 investigation. We concur with them on the need to consider the schedule for water quality improvement and to adjust the sequence of any recreation modification as appropriate in relation thereto. Likewise, we think you will wish to consider the results of the analysis that was made on the impacts of proposed flood control reservoirs in the NERBC Connecticut River Supplemental Study.

Dr. Ruth Mack of the Institute of Public Administration acted as a consultant to the Connecticut River Supplemental Study. Dr. Mack is a seasonal resident of Thetford, Vermont, and may prove to be a very valuable contact because she conducted many interviews in the Connecticut River area in preparing her assessment of Flood Management Alternatives against Social Performance Criteria. Dr. Mack may be contacted through the New England River Basins Commission's Hanover, New Hampshire, Office.

If we can assist you further, please let us know.

Sincerely yours

JAMES J. DONOGHUE
Assistant Regional Director
Land Use Coordination